More than one inseminated female in colonies of the independent-founding wasp *Mischocyttarus cassununga* von Ihering (Hymenoptera, Vespidae)

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ABSTRACT. More than one inseminated female in colonies of the independent-founding wasp *Mischocyttarus cassununga* von Ihering (Hymenoptera, Vespidae). In the primitively eusocial wasps, especially Polistini and Mischocyttarini tribes, the physiological condition of each individual is strongly associated with its dominance status in the colonial hierarchy. As a rule, in independent-founding wasps, female wasps are all morphologically alike, and their role is apparently quite flexible even as adults. However, some studies have shown that differences in body size can exist between reproductive and non-reproductive females. Thus, the present study aimed at detecting differences between reproductive (inseminated) and non-reproductive (uninseminated) individuals based on morphological and physiological parameters. We tape-recorded the daily behavioural repertory of six colonies of *Mischocyttarus cassununga* for determining the hierarchical dominance in the field, and then collected these colonies (in different cycle stages) for measuring 13 set characters, and assessing the physiological condition of each individual by inspecting their fat bodies and ovaries. Our results revealed that inseminated and uninseminated females are not significantly different in relation to body size, in spite of first group shows higher average than second in almost all measured parts. The physiological evaluation of each individual demonstrated more than one inseminated female per colony during all stages of the colony cycle, suggesting a strategic condition of this species against difficulties (predation and parasitism of the colony) in nature.

KEYWORDS. Dominance; social hierarchy; morphometry; physiology; Mischocyttarini.

RESUMO. Mais de uma fêmea inseminada nas colônias da vespa de fundação independente *Mischocyttarus cassununga* von Ihering (Hymenoptera, Vespidae). Nas vespas eusociais basais, especificamente nas tribos Polistini e Mischocyttarini, a condição fisiológica de cada indivíduo é fortemente associada com o seu status de dominância na hierarquia colonial. Como regra, nas vespas de fundação independente, as fêmeas são morfologicamente semelhantes, e suas funções são aparentemente bastante flexíveis quando adultas. Entretanto, alguns estudos têm demonstrado que diferenças no tamanho corpóreo podem existir entre as fêmeas reprodutivas e não reprodutivas. Desse modo, o objetivo do presente estudo foi detectar diferenças entre fêmeas consideradas reprodutivas (inseminadas) e não reprodutivas (não inseminadas) baseando-se em parâmetros morfológicos e fisiológicos. Um comportamento volta-vento de seis colônias de *Mischocyttarus cassununga* foi observado diariamente no campo com a ajuda de uma filmadora, e em seguida, todas as colônias em diferentes fases do ciclo foram coletadas para a mensuração de 13 caracteres e análise da condição fisiológica (quantidade de corpo gorduroso e grau de desenvolvimento ovariano) de cada uma das fêmeas. Nossos resultados revelaram que as fêmeas inseminadas e não inseminadas não são significativamente diferentes em relação ao tamanho do corpo, apesar do primeiro grupo apresentar uma média maior do que o segundo em quase todas as regiões corpóreas medidas. A análise fisiológica de cada indivíduo demonstrou a presença de mais de uma fêmea inseminada por colônia durante todas as fases do ciclo colonial, sugerindo uma condição estratégica desta espécie frente às dificuldades (predação e parasitismo da colônia) na natureza.

PALAVRAS-CHAVE. Dominância; fisiologia; hierarquia social; morfometria; Mischocyttarini.

The relation between social behaviour and physiology has been analyzed in detail in independent-founding wasps (reviewed in Markiewicz & O’Donnell 2001). The queen is the female in the nest presenting the most prominently developed ovary, and it usually dominates all the other females (workers) through agonistic behaviours, extensively monopolizing the reproductive yield of the colony (Pardi 1948; Jeanne 1972; Strassmann & Meyer 1983; O’Donnell 1998a, b). Consequently, very often the ovarian development of the subordinate workers is negatively affected by this action of the dominant female (functional queen) (Pardi 1948; Richards & Richards 1951). This way, as other studies have shown (Pardi 1948; Röseler et al. 1985), the hierarchical position of a wasp frequently depends on its reproductive physiology – i. e. the condition of dominance obtained by a female apparently triggers some physiological reaction that influences its ovarian development (Wheeler 1986).

Markiewicz & O’Donnell (2001) suggested that alterations in nutritional physiology are determined by differences in task performance. The fat body was demonstrated to be of great importance to understand the particularities of each caste (Röseler 1991), mainly because it is the principal tissue for storing energy (Paes de Oliveira 2005). Additionally, numerous studies have considered and employed the inseminated state as the main criterion for distinguishing queens from workers (Richards & Richards 1951; Shima et al. 1994, 1996a, b;
O’Donnell 1998a; Shima et al. 1998a, b). Wheeler (1996) found that oogenesis can be regulated by several key factors in a social context: nutrition, degree or nature of activity, mating, season, and conspecifics.

As a rule, castes of independent-founding wasps are not morphologically different, with queens and workers differing in their tasks in the colony (Jeanne 1986; Keeping 2000). On the other hand, recent studies with independent-founding wasps showed that the reproductive or non-reproductive condition of a female may be correlated with differences in body size and/or physiological state (Gobbi et al. 2006; Fukuda et al. 2003; Tannure-Nascimento et al. 2005; Murakami & Shima 2006). Additionally O’Donnell (1998a) claimed that studies based on measurements of the relative size and shape of structures of the three body sections – head, mesosoma, and metasoma – are necessary for a detailed comparison between queens and workers of the independent-founding wasps.

The genus Mischocyttarus is composed by a vast diversity of species; however, there are a few studies about these fascinating wasps. Although M. cassununga is characterized by the presence of only one reproductive dominant female per colony (Richard 1971, 1978), this work shows that colonies of this species present more than one inseminated female during their cycles, and as a consequence females of hierarchical higher positions probably take part in the colonies’ reproductive yield. In the present work, we aimed to analyse the species M. cassununga by using a morpho-physiological approach.

MATERIAL & METHODS

Six colonies in the post-emergence phase (four colonies in pre-male substage: 1, 2, 3, 4; and two colonies in post-male substage: 5 and 6) (Table I) were studied in the campus of Universidade Estadual Paulista – Rio Claro, Brazil (22°24′26″S, 47°33′36″W).

The ontogenetic stages of each colony were determined by checking daily both the immature forms present and the total number of adult wasps in the nest. Each wasp was individually marked with modeling acrylic paint over the mesosoma – are necessary for a detailed comparison between queens and the independent-founding wasps.

Determinations of social hierarchy. The dominance status of each female in the colony was determined based on the frequency of displayed agonistic behaviours, and determined by the method of linearization of Premnath et al. (1990). This method allowed to calculate the dominance index (Id) for each member of a colony according to the following formula:

\[ Id = \frac{\sum_{i=1}^{n} \sum_{j=1}^{m} b_{ij} + 1}{\sum_{i=1}^{n} \sum_{j=1}^{m} l_{ij} + 1} \]

Bi corresponds to the total of the frequencies when a subject dominated other members of the colony; bji is the total of the frequencies indicating when the individuals dominated by a subject dominated, in their turn, other members of the colony; “1 to m” indicates the total number of individuals dominated by the subject; Li is the total of the frequencies indicating that the subject was dominated by the other members of the colony; lji is the total of the frequencies indicating the individuals who dominated the subject and who, in their turn, were dominated by other members of the colony; and “1 to p” indicates the total number of individuals who dominated the subject.

Morpho-physiological analysis. Once the field observations were finished, all colonies were collected: each one was anesthetized with ethyl acetate, and directly fixed in Dietrich’s solution. Past 72 hours, each colony was then transferred to alcohol 70%.

From each colony, each individual wasp was measured under a stereomicroscope for the following 13 characters (further details in Fig. 1):

**Head:** HW - head width; IDm - minimum interorbital distance Mesosoma: MSL - mesoscutum length; MSW - mesoscutum width; MEL - mesoscutellum length Metasoma: T1BH - metasomal tergite I basal height; T1TH - metasomal tergite I top height; T1L - metasomal tergite I length; T3W - metasomal tergite III width; T3H - metasomal tergite III height; T1W - metasomal tergite IV width; T1H - metasomal tergite IV height (width and height of these tergites was measured with them positioned between glass slides).

**Right wing:** WL - right wing length Those characters were chosen based on Shima (1991) and Shima et al. (2000a).

After taking the measurements, the wasps were depicted in a WILD-Leica light chamber. Based on these drawings the following factors intrinsic to reproductive development were evaluated:

**Ovary development:** To evaluate the ovarian degree of development of each individual, we based on our previous study made in this same species (Fig. 2: Murakami & Shima 2006).

**Spermatheca content:** We separated inseminated from uninseminated females based on the relative opacity of the spermathecae, also checking for the presence of a rounded compact mass, as was efficiently done in previous studies (Shima et al. 1994, 1996a, b; Shima et al. 1998, 2000a, b, 2003; Noda et al. 2003).

Relative quantity of fat: This was visually estimated by comparison, i.e. females were divided in four groups: 25%; 50%; 75% and 100%. Based on this, it was possible to correlate the physiological status with the kind of task in the colony of each female according to its age.

Statistical analysis. The morphometric data were log-transformed for the adequacy of normality. A stepwise Discriminant Analysis (Zar 1999) was applied to the 13 morphological characters with the main objective of comparing inseminated females with uninseminated ones.

The colonies were grouped according to the colonial cycle.
substage (pre-male and post-male) for detecting variations according to the colonial stage of development. In the pre-emergence stage it was impossible comparing inseminated and uninseminated females because all nests were founded by a single female (haplometrosis). Consequently, based on the comparison between the two groups of females, we hoped to clarify characters that can help discern inseminated from uninseminated females in *M. cassununga*.

**RESULTS**

Establishment of social hierarchy. According behaviours of dominance and subordination, our results show the presence of a stable linear hierarchy during the pre- and post-male substages. The dominant female of the social hierarchy achieves a highest value of dominance index (Id) in relation to other females of colony, i.e. it was the most aggressive female in the colony (Fig. 3). The female which occupied the second position in the ranking showed the second highest value of Id, and so forth. The individuals just below the dominant female in the social ranking were considered females of higher hierarchically positions and called of the sub-dominant females. The females which showed a lower value of dominance index were considered subordinate females.

Morphometric analysis of the different substages. The measurements of 13 characters revealed that inseminated females tend to be slightly larger than uninseminated females in almost all body parts, except to T1BH, T3W in the pre-male stage and HW, T1BH, T1TH in the post-male stage (Table II). Despite these differences of averages between two groups the Discriminant Analysis shows that these differences are not significant (Table III). Wilks’ lambda values were close to 1. Furthermore, predicted vs observed classifications, based on discriminant analysis, show that inseminated groups are not well defined as uninseminated females (Table IV). The dominant female of colony 5 was not analysed by morphophysiological aspects because it disappeared before the collection.

Degree of ovarian development, insemination, relative quantity of fat body, and age during the colony cycle. The results demonstrate that the ovaries of inseminated females were more developed than those of uninseminated ones during the pre- and post-male substages (Figs. 4 and 5). Regarding the colony cycle, the total number of wasps with well-developed ovaries (patterns A and B) was greater in the pre-male than in the post-male substages.
All ovaries examined exhibited at least some degree of development and neither filamentous nor atrophic ovaries were found (Figs. 4 and 5). This can indicate that the dominant females of *M. cassununga* are not capable of inhibiting the development of their subordinates’ ovaries (sub-dominant females) and, consequently, subordinate females (presenting ovaries in patterns D or E) did not completely lose their reproductive capacity.

Regarding the analysis of the contents of the spermathecae, our dissections revealed that there was always more than one inseminated female (dominant female and sub-dominant females) per colony during all colony cycle (Figs. 4 and 5). Furthermore, our results show that sub-dominant females are daughters of dominant female in the colony 2 (Fig. 4). The inseminated females with well-developed ovaries (dominant and sub-dominant females which already present in the colony at the beginning of the observations) were the oldest in the nests, while most subordinates (females which emerged from its colonies, respectively) were the youngest (Figs. 4 and 5). Still on the subordinate wasps, among all that were collected during the post-male substage (from colonies Bc1 and S3), only three wasps from colony Bc1 (aged 38, 41, and 42 days) were older than sub-dominant females of the same colony (age ranging 11–34 days). All the other subordinates were younger than the dominant females.

Although the dominant female and sub-dominant females presented much fat body and well-developed ovaries (inseminated ones with patterns A or B from pre- and post-male substage colonies) some subordinate females of lower hierarchically positions with less developed ovaries also presented great quantity of fat body (uninseminated females with pattern C from pre-male and E condition in post-male substages) (Figs. 4 and 5). The dominant female of colony 6 with developed ovary exhibited little relative quantity of fat body in the post-male substage.

Oviposition during the substages of the colonial cycle.

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Table I. Stage, substage, number of collected wasps, period and time of observation of collected colonies in *Mischocyttarus cassununga*.

<table>
<thead>
<tr>
<th>Colony ontogeny</th>
<th>Nest</th>
<th>Number of adult wasps</th>
<th>Number of Inseminated females</th>
<th>Observation</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-emergence</td>
<td>Pre-male</td>
<td>1</td>
<td>10</td>
<td>3</td>
<td>22/03 to 23/06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>11</td>
<td>3</td>
<td>13/08 to 08/11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>06/04 to 06/05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>15/06 to 23/08</td>
</tr>
<tr>
<td>Post-male</td>
<td>5</td>
<td>29</td>
<td></td>
<td>6</td>
<td>13/07 to 22/12</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>23</td>
<td></td>
<td>7</td>
<td>16/05 to 01/08</td>
</tr>
</tbody>
</table>

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Fig. 2. Pattern of ovarian development in *Mischocyttarus cassununga* (Adapted from MURAKAMI and SHIMA 2006). (ovary A = very developed, ovaries B and C = developed enough, ovary D = moderately developed and ovary E = little developed).
Our results revealed that more than one inseminated female can lay eggs in the same colony during all colony cycle (Table V). Particularly, the whole development of two eggs oviposited by two sub-dominant females (from colony Bc1) were observed, and consequently, two male wasps emerged. The emergence of males indicates that these females (which were namely verm and amv) probably had not been inseminated prior to oviposition. The remaining eggs in this colony were either destroyed by parasitism (by ichneumonids or by the fly *Megaselia scalaris* Loew, 1866), and during the reproductive competition between dominant and sub-dominant females, probably by differential oophagy. The occurrence of differential oophagy was noted during the mapping of nests when the disappearance of eggs or change in its position occurred.

**DISCUSSION**

**Morphometry.** Until recently, it was thought that there were no morphological differences among adult wasps of independently founded colonies of Polistinae. On the other hand, some previous studies have shown that there are differences in body size between reproductive and non-reproductive females of independent-founding wasps (Gobbi et al. 2006 with *Polistes versicolor* Olivier, 1791; Tannure-Nascimento et al. 2005 with *Polistes satan* Bequaert, 1940; Fukuda et al. 2003 with *Ropalidia plebeiana* Richards, 1978). Through Discriminant Analysis we did not detect significant morphological differences between the inseminated and un inseminated females during pre- and post-male substages. However, despite these results we suggest the presence of a potential difference pronounced at the gaster, mainly pertaining the height of the metasomal tergite III (T3H) (Table III). We

<table>
<thead>
<tr>
<th>Measured characters</th>
<th>Pre-male</th>
<th>Post-male</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW</td>
<td>2.73 ± 0.14</td>
<td>2.59 ± 0.08</td>
</tr>
<tr>
<td>IDm</td>
<td>1.10 ± 0.06</td>
<td>1.07 ± 0.03</td>
</tr>
<tr>
<td>MSL</td>
<td>1.84 ± 0.13</td>
<td>1.81 ± 0.06</td>
</tr>
<tr>
<td>MSW</td>
<td>1.81 ± 0.10</td>
<td>1.80 ± 0.06</td>
</tr>
<tr>
<td>MEL</td>
<td>4.15 ± 0.22</td>
<td>4.05 ± 0.15</td>
</tr>
<tr>
<td>T1BH</td>
<td>0.36 ± 0.03</td>
<td>0.35 ± 0.02</td>
</tr>
<tr>
<td>T1TH</td>
<td>0.68 ± 0.08</td>
<td>0.64 ± 0.04</td>
</tr>
<tr>
<td>T1L</td>
<td>2.58 ± 0.16</td>
<td>2.57 ± 0.09</td>
</tr>
<tr>
<td>T3W</td>
<td>4.17 ± 0.19</td>
<td>4.07 ± 0.16</td>
</tr>
<tr>
<td>T3H</td>
<td>1.77 ± 0.15</td>
<td>1.75 ± 0.09</td>
</tr>
<tr>
<td>T4W</td>
<td>3.99 ± 0.19</td>
<td>3.86 ± 0.14</td>
</tr>
<tr>
<td>T4H</td>
<td>1.53 ± 0.11</td>
<td>1.48 ± 0.08</td>
</tr>
<tr>
<td>WL</td>
<td>4.00 ± 0.19</td>
<td>3.85 ± 0.10</td>
</tr>
</tbody>
</table>

Table II. Measurements (X ± SD) of 13 morphological characters (HW - head width; IDm - minimum interorbital distance; MSL - mesoscutum length; MSW - mesoscutum width; MEL - mesocutellum length; T1H - metasomal tergite I basal height; T1TH - metasomal tergite I top height; T1L - metasomal tergite I length; T1W - metasomal tergite III height; T1W - metasomal tergite IV width; T1H - metasomal tergite IV height; WL - right wing length) of the inseminated females (I) and uninseminated females (NI) from colonies in the pre-male and post-male substages of *M. cassununga*.
think this might be related to pattern of ovarian development, as reported by Murakami & Shima (2006) to happen with the same species. Thus, indicating that greater body size in *M. cassununga* can aid the wasps achieve social / reproductive dominance, but it is probably of secondary relevance in face of hormonal and nutritional traits, as related by Keeping (2000) in *Belonogaster petiolata* Degeer, 1778.

Physiological aspects. In several independent-founding wasps the production of eggs by subordinates is apparently not wholly suppressed, but takes place at different rates according to their hierarchical rank (Pardi 1948; Litte 1977, 1979, 1981; West-Eberhard 1986; Suzuki 1987; Röseler 1991). For example, in *Mischocyttarus mexicanus* de Saussure, 1854 (Litte 1977) and *M. labiatus* Fabricius, 1804 (Litte 1981), non-egg-laying foundresses lay eggs inside the nest cells immediately after the natural disappearance or removal of the queen. Our results show that the inhibition of ovary does not happen in *M. cassununga* and also that the dominant female
More than one inseminated female in colonies of the independent-founding wasp is apparently tolerant to the presence of other potential reproductive females (sub-dominant females) in a same colony. Interestingly, the number of inseminated females and females with well-developed ovaries even increased during the colony cycle (Figs. 4 and 5). Similar results were observed in *Polistes annularis* Linnaeus, 1763 by Strassmann (1983) and in *Ropalidia marginata* Dover and Rao, 1922 and *R. cyathiformis* van der Vecht, 1941 by Deshpande et al. (2006).

We suggest that the presence of more than one inseminated female in the same colony might be beneficial to the nest cycle in the present species, since when the queen disappears or dies the colony would ultimately be doomed without another wasp capable of superseding it.

According to Simões et al. (1985), of all species of the...
genus *Mischocyttarus* occurring in the vicinities of Rio Claro, *M. cassununga* is the most abundant one, suggesting some local adaptation edge in relation to the others *M. drewsensi, M. cerberus styx* Richards, 1940, and *M. montei* Zikán, 1949, most markedly during the cold periods. We think there that the great plasticity of behaviour in independent-founding wasps, as described by Litte (1979, 1981) with *Mischocyttarus flavitarsis* Saussure, 1854 and *M. labiatus*, respectively, coupled with the presence of more than one inseminated wasp per colony in *M. cassununga* (Murakami & Shima 2006) may account for the predominance of this species in this area, which is observed until recent days (personal observation).

Wheeler (1994) once said that an increment of fat tissue precedes the development of oocytes, and that these display intense metabolic activity during the process of posture, mainly by producing vitellogenin. Shima *et al.* (2003) observed that some workers of *Protonectarina sylveirae* de Saussure, 1854 and *M. labiatus*, respectively, coupled with the presence of more than one inseminated wasp per colony in *M. cassununga* (Murakami & Shima 2006) may account for the predominance of this species in this area, which is observed until recent days (personal observation).

**Table III.** Discriminant morphometric variables between inseminated and uninseminated females of *Mischocyttarus cassununga* in the pre- and post-male (Number of variables in the model: 3; Wilks’ lambda: 0.9095 approx. *F* = 1.5425, *p* < 0.0298) and post-male (Number of variables in the model: 3; Wilks’ lambda: 0.8151 approx. *F* = 3.6302, *p* < 0.0193) substages using the stepwise procedure.

<table>
<thead>
<tr>
<th>Pre-male Wilks’ lambda</th>
<th>F-remove (1.31)</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>T3H 0.9999</td>
<td>3.0847</td>
<td>0.0889</td>
</tr>
<tr>
<td>T3W 0.9501</td>
<td>1.3846</td>
<td>0.2482</td>
</tr>
<tr>
<td>Post-male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilks’ lambda</td>
<td>F-remove (1.48)</td>
<td>p-level</td>
</tr>
<tr>
<td>T3H 0.8970</td>
<td>4.8283</td>
<td>0.0328</td>
</tr>
<tr>
<td>MSL 0.9126</td>
<td>5.7437</td>
<td>0.0204</td>
</tr>
<tr>
<td>MSW 0.8715</td>
<td>3.3234</td>
<td>0.0745</td>
</tr>
</tbody>
</table>

Original data are based in millimeters.

Mutual tolerance among reproductive females. Our study demonstrates the presence of more than one inseminated female which would be able to lay diploids eggs in the colonies. Similar results were related by Oliveira (2007) in *Mischocyttarus montei* and Silva (2008) in *Mischocyttarus cerberus styx*. Unfortunately, we have not found solid indications that there is more than a single egg-laying wasp in the colonies, and that this is probably commonplace with *M. cassununga*. The behavioural data showed that almost all eggs (which were oviposited by more than one female per colony) had its development interrupted (by parasitism or by collection of colonies). On the other hand, we have obtained robust behavioural, morphological and physiological evidences implying that females of higher hierarchical positions could be taking part in the reproductive yield during the development of the colonies (Table V). The fact of inseminated females of higher hierarchically positions (potential reproductive females which were produced in the colony) remain in the colony rather than abandon it to found its own nest suggests a new aspect.

**Table IV.** Classification matrix between predicted and observed classifications of inseminated (I) and uninseminated (NI) females after discriminant analysis in *Mischocyttarus cassununga*.

<table>
<thead>
<tr>
<th>Group</th>
<th>Percentage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>3.37</td>
<td>12</td>
</tr>
<tr>
<td>NI</td>
<td>96.63</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>50</td>
</tr>
<tr>
<td>Post-male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0.25</td>
<td>5</td>
</tr>
<tr>
<td>NI</td>
<td>99.75</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>37</td>
</tr>
</tbody>
</table>

* The development of some eggs was interrupted by the collection of colony.
of the biology of *M. cassununga*. Similar result was related by Murakami & Shima (2006), that is, the inseminated females of higher hierarchically positions just below the dominant female in the social ranking (sub-dominant females) are daughters which emerged from the colony and does not leave it. Based on this results we suggest that all females of higher hierarchically positions are probably daughters of dominant female. In the field of São Paulo State University – Campus of Rio Claro, the colonies of *M. cassununga* are predominantly founded by haplometrosis (personal observations), where there is a stable linear hierarchy during the colony development (Murakami & Shima 2006). It also can help to explain the abundance of this species in the Campus during all season of year.

Finally, our study depicted partially a life strategy of *M. cassununga* that might account for an apparent edge over other species in the field (personal observations). The presence of more than one inseminated female with well-developed ovary, and the capacity of laying viable eggs increase the chances of success of the colony cycle. We would like to propose that this species should be regarded as a useful study model to understand the tolerance of more than one inseminated female in the same colony in post-emergence stage, premale substage of *Mischocyttarus*.

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