

Inquilines of *Brachymenes dyscherus* nests with special reference to *Monobia schrottkyi* (Hymenoptera, Vespidae, Sphecidae)

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Abstract: Sixty-four inactive nests of the solitary mud-daubing wasp *Brachymenes dyscherus*, reused by 5 inquiline species, were collected at Fazenda Santa Carlota, Cajuru, São Paulo, Brazil in 1995 and 1996. *Monobia schrottkyi* used 52 nests; among the 717 cells available for use, 502 were reused. The number of cells per nest varied from 3 to 24; 1 to 16 individuals emerged from September to April (154 males and 112 females). Forty-six cells were parasitized by *Melittobia* sp. (n = 44) and Ichneumonidae (n = 2). *Monobia curvata* used 3 nests; among the 50 cells available for use, 38 were reused and 15 males and 8 females emerged from August to November. Three cells were parasitized by Ichneumonidae. *Montezumia petiolata* occupied 1 nest; among the 8 available cells, 7 were reused and 2 males and 3 females emerged in September. *Podium denticulatum* used 2 nests; the 20 cells available for use were reused and 11 males and 4 females emerged in August. *Trypoxylon rogenhoferi* used 5 nests that had 65 available cells; 48 of them were reused, from which 19 males and 11 females emerged from September to November. Three cells were parasitized by Ichneumonidae (n = 2) and Chrysididae (n = 1).

Key words: Eumeninae, Sphecidae, inquilinism, *Monobia*, *Montezumia*, *Podium*, *Trypoxylon*.

Several species of solitary wasps utilize previously existing cavities for nest construction, including the abandoned mud nests constructed by sphecids, which provide a large number of cavities (open and empty cells). Among them, several species belonging to the genera *Monobia* and *Montezumia* (Vespidae: Eumeninae), *Trypoxylon* and *Podium* (Sphecidae) have been found occupying such abandoned nests (Rau 1940, Krombein 1967, Freeman and Jayasingh 1975, Fritz and Genise 1980, Willink 1982, Genaro 1994).

Monobia and *Montezumia* are Neotropical, most species being present in the moist forests of South America, yet some species occur in the Nearctic region (Willink 1982). *Monobia schrottkyi* Bertoni, 1918 occurs in northern Argentina, Paraguay and Brazil; *Monobia curvata* Fox, 1899 occurs in Bolivia and Brazil,

and *Montezumia petiolata* Saussure, 1855 is distributed from Venezuela and Colombia to northern Argentina (Willink 1982). According to Bohart and Menke (1976), *Podium* is primarily a Neotropical genus, occurring in the eastern half of North America where one species ranges as far north as New York; *P. denticulatum* Smith, 1856 is found from Mexico to Brazil. *Trypoxylon* is a cosmopolitan genus, but poorly represented in Australia and the various Pacific island groups; *T. rogenhoferi* Kohl, 1884 occurs in Argentina and Brazil (Bohart and Menke 1976).

The purpose of this paper is to present biological data on *M. schrottkyi*, *M. curvata*, *M. petiolata*, *T. rogenhoferi* and *P. denticulatum* as inquilines of *Brachymenes dyscherus* Saussure, 1852 nests.

MATERIALS AND METHODS

Study site: The study was carried out in four locations at Fazenda Santa Carlota, Cajuru, São Paulo, Brazil (21° 17' – 18' S, 47° 12' – 18' W). The study area covers 6 300 ha, with altitudes ranging from 540 to 944 m, and it is drained by several streams. Of the total area, approximately 2 200 ha is covered by native vegetation preserved in isolated patches or gallery forests (semideciduous forests, riparian forests, *cerrados* and *cerradões*) surrounded by cultivated land and/or pastures. There are some areas at various stages of secondary growth of the main vegetation types. The predominant soils are Rhodic Ferralsol and Orthic Ferralsol (Oliveira *et al.* 1983). The study area contained various abandoned rural buildings, surrounded by pastures, plantations (mainly sugar cane), and abandoned orchards

Two seasons, distinguished by temperature and precipitation, are recognized in this region: 1- Cold and dry season (May to August) with monthly average temperatures ranging from 18 to 22 °C and precipitation from 0 to 81.7 mm; 2- Hot and wet season (September to April) with monthly average temperatures ranging from 19.9 to 26.1 °C and precipitation from 35.3 to 422.6 mm.

Nests: Sixty-three inactive nests of *B. dyscherus* with reused cells (5 nests on 6/21/95, 15 on 7/7/95, 31 on 7/13/95, 2 on 8/15/95, 1 on 9/13/95, 4 on 10/5/95 and 5 on 8/2/96) were collected from the walls inside abandoned houses, using a pallet knife. The closure plugs, generally constructed with mud of different colors or presenting a little depression, helped identify the reused cells. In the *P. denticulatum* cells the closure plugs were polished and shiny. When, as happened in some nests, the immatures from the first layer in contact with the substrate were exposed, they were collected and placed in labeled individual vials and identified. In the laboratory all nests were placed in plastic boxes and together with the vials were kept at room temperature until the adults emerged. After emergence the nests were opened to analyze their cells. All the wasps are

deposited in the Entomology Collection of Biology Department-FFCLRP-USP.

Nests of *Brachymenes dyscherus*: The nests were constructed with mud on the interior walls of abandoned houses located at least 1 m from the floor, in dry and shaded places. They were composed of 1 to 4 layers, with cells constructed in two parallel series. Once completed, the nests were wholly covered with mud, resulting in a distinctive shape. The surface was rough and in some cases it was impossible to distinguish individual cells. The number of cells per nest ranged from 3 to 62, and they were provisioned with larvae of Lepidoptera (from 4 to 29 preys). In nests with 4 layers, the maximum number of cells counted was 23 for the first layer, 20 for the second, 16 for the third, and 5 for the fourth. The cocoons, milkish white and more or less transparent, were affixed to the cell walls; remains of prey together with larval feces were found adhered to the external surface of the cocoons. *Brachymenes dyscherus* is a univoltine species whose immatures undergo prepupal diapause. The development period ranges from 158 to 309 days for males, and from 167 to 320 days for females. Most larvae develop into adults during the same year of nest construction, with the greatest number of emergences occurring from September to December, although some individuals had much longer development periods (from 343 to 595 days). The sex ratio was 1.5 males to 1 female (Camillo 1999).

RESULTS

In nests (n = 63) of *B. dyscherus*, of 1 127 original cells there were 860 (76.3 %) available for use, of which 615 (71.5 %) were reused by inquiline species. Of these nests 52 were occupied exclusively by *M. schrottkyi*, 3 by *M. curvata*, 1 by *M. petiolata*, 2 by *P. denticulatum* and 5 by *T. rogenhoferi*. Cells not reused (sealed) contained old material from the first generation. The percentage of available cells, in relation to total number of cells in the

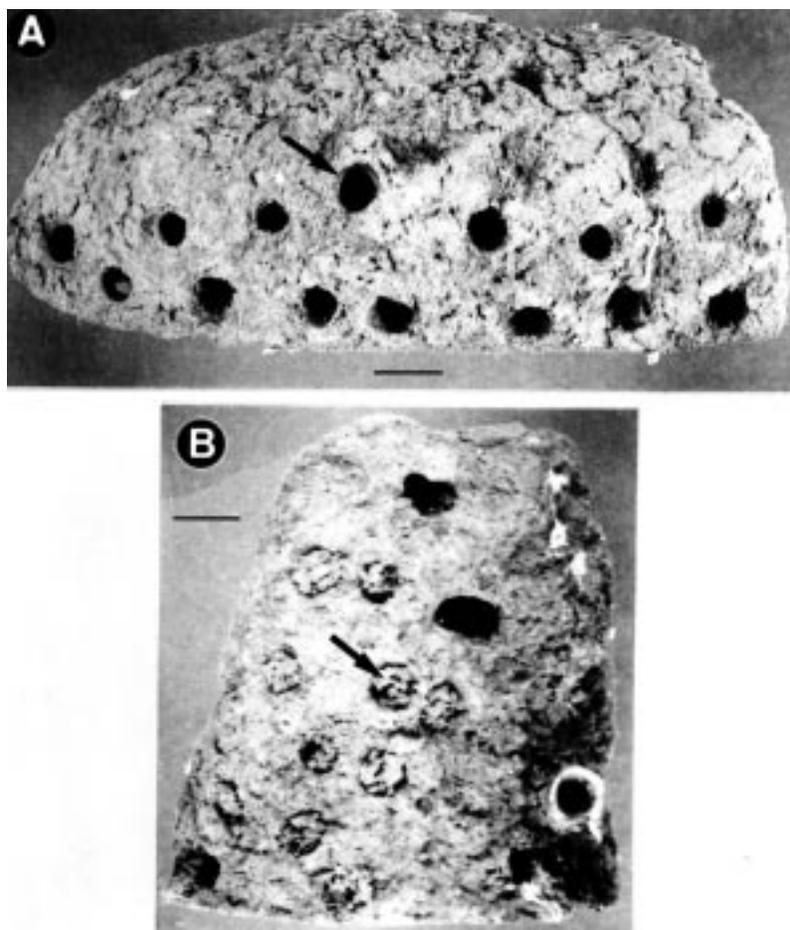


Fig. 1. A - Nest of *Brachymenes dyscherus* with several cells available for use; B - Reused cells showing the closure plugs. The lines correspond to 1.0 cm.

nests of each species and those reused, in relation to available cells were statistically similar ($X^2 = 4.39$ and $X^2 = 7.27$, $gl = 4$, $p < 0.05$, respectively). Correlation among these percentages was negative and significant ($r = 0.91$, $p < 0.05$) (Table 1). Cells of *B. dyscherus* available for use and reused by inquilines can be observed in the Fig. 1.

Only 3 nests of *B. dyscherus* were used by two different inquiline species. One of these, collected on 7/13/95 with 28 original cells and 21 available, was used by *P. denticulatum* and *M. schrottkyi*. The first species reused 10 cells in which 2 dead females and 8 dead immatures were found; the second one reused only 2 cells, from which 1 male (11/8/95) and 1 female

(12/23/95) emerged. *Parancistrocerus areatus* Fox (two individuals) and *T. rogenhoferi* emerged from the other two nests. The data from the first case and from *P. areatus* is not reported in the tables and figs.

Monobia schrottkyi

This species used 52 nests of *B. dyscherus*, which had 922 cells; among the 717 available for use 502 were reused (Table 1). The number of reused cells per nest varied from 3 to 24, with most nests having from 6 to 11 cells (Fig. 2). The number of individuals emerged per nest ranged from 1 to 16 with most nests having from 1 to 6 individuals (Fig. 3).

In total, 258 individuals of *M. schrottkyi* emerged from September (9/4/95) to April (4/2/96) (hot and wet season), with the greatest frequency occurring in January (Fig. 4). Monthly numbers of these emergences, according to the date of collection of the *B. dyscherus* nests, are presented in Table 2. It is worth emphasizing that eight individuals were found dead inside

the cells. All immatures were in prepupal diapause when the nests were collected.

The sex ratio, determined for the total population produced, independently of the season of nests collection, was 154 males to 112 females, which was significantly different from 1:1 ($X^2 = 6.32$, $gl = 1$, $p < 0.05$).

Mortality in *M. schrottkyi* and in the other four inquiline species was statistically

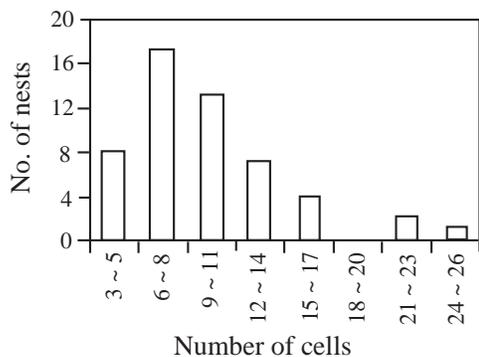


Fig. 2. Frequency distribution of the number of cells reused by *Monobia schrottkyi* in nests of *Brachymeres dyscherus*.

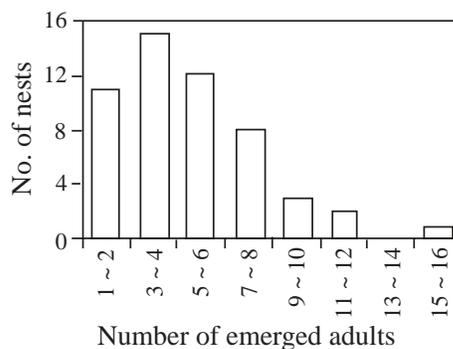


Fig. 3. Frequency distribution of the number of individuals of *Monobia schrottkyi* emerged from nests of *Brachymeres dyscherus*.

TABLE 1
Collection date and number of nests of *Brachymeres dyscherus*, number of original cells, number and percentage of cells available for use and reused by inquiline species

Species inquilines	Dates of host nest collection	Nº of nests	Nº of cells	Nº and (%) of cells available for use	Nº and (%) of reused cells
<i>M. schrottkyi</i>	06/21/95	5	82	56	45
	07/07/95	15	192	157	124
	07/13/95	26	512	420	261
	09/13/95	1	23	20	12
	08/02/96	5	113	64	60
Total		52	922	717 (77.7)	502 (70.0)
<i>M. curvata</i>	07/13/95	3	65	50 (76.9)	38 (76.0)
<i>M. petiolata</i>	07/13/95	1	13	8 (61.5)	7 (87.5)
<i>P. denticulatum</i>	07/13/95	2	35	20 (57.1)	20 (100)
<i>T. rogenhoferi</i>	08/15/95	1	24	18	16
	10/05/95	4	64	47	32
Total		5	92	65 (70.6)	48 (71.5)
TOTAL		63	1 127	860 (76.3)	615 (71.5)

TABLE 2

Collection dates of the *Brachymenes dyscherus* nests and monthly number of emergences of *Monobia schrottkyi*

Collection dates	Number of emergences*												Total
	J	F	M	A	M	J	J	A	S	O	N	D	
06/21/95	16	-	1	-	-	-	-	-	-	-	4	4	25
07/07/95	42	4	2	1	-	-	-	-	-	-	4	15	68
07/13/95	74	4	11	-	-	-	-	-	6	-	12	22	129
09/13/95	6	-	-	-	-	-	-	-	-	-	-	3	9
08/02/96	1	-	-	-	-	-	-	-	-	3	2	21	27
Total	139	8	14	1	-	-	-	-	6	3	22	65	258

* - 8 individuals found dead inside the cells not presented.

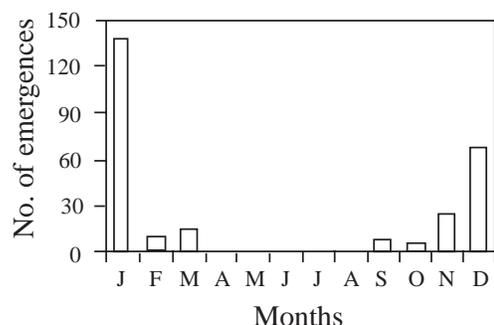


Fig. 4. Monthly number of emergences of *Monobia schrottkyi* in nests of *Brachymenes dyscherus*.

similar ($X^2 = 4.3$, $gl = 4$, $p > 0.05$). Among the reused cells, 44 were parasitized by *Melittobia* sp. (Eulophidae) and 2 by Ichneumonidae (Table 3).

Monobia curvata

This species used 3 nests of *B. dyscherus*, which had 65 cells. Among the 50 available for use, 38 were reused (Table 1). The number of reused cells per nest was 8, 15 and 15, of which emerged 5, 7 and 11 individuals, respectively. The emergences started in the final part of the cold and dry season, in August (8/28/95) ($n = 2$) extending to September ($n = 10$), October ($n = 6$) and November (until 11/19/95) ($n = 3$). In addition, one individual was dead inside the cell and for another, the emergence date was not determined. The sex

ratio was 15 males to 8 females, which was not statistically different from 1:1 ($X^2 = 1.56$, $gl = 1$, $p > 0.05$). Among the reused cells, three were parasitized by Ichneumonidae (Table 3). When the nests were collected, all immatures were in prepupal diapause.

Montezumia petiolata

This species used 1 nest of *B. dyscherus* with 13 cells, of which 8 were available for use. Of these, 7 were reused (Table 1), and 5 individuals (2 males and 3 females) emerged in September (from 9/2 to 9/11/95). When the nests were collected all immatures were in prepupal diapause.

Podium denticulatum

This species used 2 nests of *B. dyscherus* with 35 cells, which had 20 cells available for use. Of these, 5 in one nest and 15 in another were reused (Table 1). In August (from 8/14 to 8/27/95) 1 and 12 individuals emerged, respectively. In each nest 1 adult was dead inside the cell. The sex ratio was 11 males to 4 females, which is not significantly different from 1:1 ($X^2 = 2.40$, $gl = 1$, $p > 0.05$).

Trypoxylon rogenhoferi

This species used 5 nests of *B. dyscherus* that had 92 cells. Of these 48 were reused among the 65 available for use (Table 1). In the nests 3, 8, 10, 11 and 16 cells were reused,

TABLE 3
 Total of reused cells, adults emerged, dead immatures, cells with lost material or empty,
 and parasitized cells of the inquiline species

Species	Reused cells	Emerged adults	Dead immatures			Others*	Parasitized cells	Total and (%) of dead immatures and parasitized cells
			Eggs + Larvae	Pre-pupae	Pupae			
<i>M. schrottkyi</i>	502	266	65	61	44	20	46	236 (47.0)
<i>M. curvata</i>	38	23	5	4	3	-	3	15 (39.4)
<i>M. petiolata</i>	7	5	1	-	1	-	-	2 (28.5)
<i>P. denticulatum</i>	20	15	4	1	-	-	-	5 (25.0)
<i>T. rogenhoferi</i>	48	30	14	1	-	-	3	18 (37.5)

* - Cells found empty or whose material was lost are included in this column.

from which 2, 2, 5, 9 and 12 individuals emerged, respectively. The emergences from nests collected on 8/15/95 occurred in September (from 9/8 to 9/16/95) (n = 13), and for those collected on 05/10/95, the emergences occurred in October (10/31/95) (n = 2) and November (until 11/19/95) (n = 15). The sex ratio was 19 males to 11 females, which was not statistically different from 1:1 ($X^2 = 1.62$, $gl = 1$, $p > 0.05$). Three of the reused cells were parasitized, producing individuals from the families Ichneumonidae (n=2) and Chrysididae (n = 1).

DISCUSSION

Iwata (1976) classified the nesting habits of solitary Vespidae into three categories: 1-borrowers that excavate nests in the soil; 2-builders that construct their entire nests from materials such as mud or masticated plant material and 3- renters that occupy and modify preexisting cavities. These are opportunistic and occupy a wide variety of cavities such as the pith of twigs, cavities in dead plants, or cells of abandoned mud dauber nests (Cowan 1991).

Species classified as inquilines can occupy and manipulate cells of old mud nests made by other solitary wasps. The mud used in these nests is quite durable and does not wash away in rain, perhaps because of the addition of saliva to the water and soil which would

strengthen the nest (Isely 1913), as has been suggested for a sphecid (Qureshi and Ahmad 1978 in Cowan 1991). According to Genaro (1994), the nests of *Sceliphron* spp., are highly durable and can remain intact for 7 years (Freeman 1974). Nests of *Sceliphron* spp. are similar to those of *B. dyscherus* studied in this work, and are reused by several Vespidae and Sphecidae (see for example Krombein 1967, Freeman 1973, Willink 1982, Genaro 1994).

The inquilines studied in this work used abandoned nests of *B. dyscherus* because their open cells serve as suitable cavities. Thus, these species presented similar behavior to those that nest in preexisting cavities. For some species the inquilinism here observed seems to be facultative, because in the vicinity, and during the same period, nests of *T. rogenhoferi* (Camillo *et al.* 1994), *P. denticulatum* (Camillo *et al.* 1996) and *Monobia angulosa* Saussure, 1852 (Camillo *et al.* 1997) were obtained from bamboo cane trap-nests.

According to Evans (1973) the genus *Montezumia* could have species that nest in the soil (*M. infernalis* (Spinola, 1851), *M. nigriceps* (Spinola, 1841)) and others which construct free mud nests (*M. ferruginea*, *M. dimidiata* Saussure, 1852, *M. cortesioides* Willink, 1982). Nevertheless and according to Willink (1982) this classification should be reconsidered, because the only data on species that construct nests in soil correspond to those two previously mentioned and this is

impossible to confirm. Previously, Strand (1912 in Willink 1982) observed *M. infernalis* constructing free nests or nests in wall cavities, but not in the soil.

Recent observations have been made in relation to species that could construct free nests: *M. ferruginea*, *M. dimidiata*, *M. cortesioides*, *M. vechti* Willink, 1982, *M. pelagica* Saussure, 1852, *M. brethesi* Bertoni, 1918 and *M. platina* Saussure, 1852 (Willink 1982). The possibility that they were inquilines, as observed by Fritz and Genise (1980) in *M. ferruginea*, was not mentioned in any of these cases; nevertheless the majority of the mentioned cases of mud nests could correspond actually to species that use abandoned nests of other wasps (in Willink 1982). As observed in this study, *M. petiolata* is an inquiline of *B. dyscherus* nests.

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RESUMEN

Se recolectaron 64 nidos inactivos de la avispa untadora de barro solitaria *Brachymenes dyscherus* reusados por 5 especies inquilinas en Fazenda Santa Carlota, Cajuru, São Paulo, Brasil en 1995 y 1996. *Monobia schrottkyi* usó 52 nidos; entre las 717 celdas disponibles, 502 fueron reusados. El número de celdas por nido varió de 3 a 24; de 1 a 16 individuos emergieron desde setiembre hasta abril (154 machos y 112 hembras). Cuarenta y seis celdas fueron parasitadas por *Melittobia* sp. (n = 44) e Ichneumonidae (n = 2). *Monobia curvata* usó 3 nidos; entre las 50 celdas disponibles, 38 fueron reusadas y 15 machos y 8 hembras emergieron desde agosto hasta noviembre. Tres celdas fueron parasitadas por Ichneumonidae. *Montezumia petiolata* ocupó un nido; entre las 8 celdas disponibles, 7 fueron reusadas y 2 machos y 3 hembras emergieron en

setiembre. *Podium denticulatum* usó 2 nidos; las 20 celdas disponibles fueron reusadas y 11 machos y 4 hembras emergieron en agosto. *Trypoxylon rogenhoferi* usó 5 nidos que tuvieron 65 celdas disponibles; 48 fueron reusadas, de las cuales emergieron 19 machos y 11 hembras desde setiembre hasta noviembre. Tres celdas fueron parasitadas por Ichneumonidae (n = 2) y chrysididae (n = 1).

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