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Article

Nesting ecology of *Megachile* (*Sayapis*) *mendozana* Cockerell and its synonymy with *Megachile* (*Sayapis*) *santiaguensis* Durante (Hymenoptera: Megachilidae)

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Abstract

We synonymized *M. santiaguensis* Durante with *M. mendozana* Cockerell based on individual siblings of different sex obtained from a trap-nest. Similarity in morphology between individuals of both sexes of *M. mendozana*, as well as the overlapping distribution, provides further evidence to support this synonymy. Also, we report aspects of nesting ecology and analyze the pollen in cell provisions and/or feces of 11 samples of 4 different trap-nests. Additionally, floral host, associated organisms, and new geographical records are provided.

Key words: Megachilini, leafcutter bees, Argentina, trap-nests, *Melittobia*

Introduction

Bees included in *Megachile* Latreille s.l. constitute a large and diverse genus of Megachilidae and are represented by approximately 1561 solitary species present in all continents, except Antarctica (Ascher & Pickering 2011). In the New World, the history of this genus has undergone numerous changes. Recently, Michener (2000; 2007) recognized a large genus *Megachile* and grouped the subgenera into three informal groups. The subgenus *Sayapis* Titus has an incomplete cutting edge in the second interspace and could be a member of Group 1 in spite of its elongated body. Michener (2000; 2007) considers *Sayapis* related to the monotypic Palearctic subgenus *Eumegachile* Friese, but such a relationship is not supported in the phylogenetic analysis of Gonzalez (2008), in which the monotypic South American subgenus *Schrottkyapis* Mitchell is synonymized with *Sayapis*.

The subgenus *Sayapis* ranges across North America to Argentina and about 25 species are currently known (Ascher & Pickering 2011). Durante & Díaz (1996) revised the Argentinean species under the generic name *Eumegachile* and recognized a total of eight species. All species are known from either the female or the male, except for *M. planula* Vachal which is known from both sexes. This fact could be due to the great sexual dimorphism exhibited in most species.

Megachile mendozana was described by Cockerell (1907) based on three females from Mendoza, Argentina. Later, Durante described *M. santiaguensis* (Durante & Díaz 1996) from two males from Santiago del Estero, Argentina. Both taxonomic entities are widely distributed in Argentina: *M. mendozana* occurs in the Provinces of Catamarca, Chaco, Córdoba, La Pampa, La Rioja, Mendoza, Misiones, San Juan, Santa Fe, and Santiago del Estero; *M. santiaguensis* occurs in Mendoza, Misiones, San Juan, and Santiago del Estero (Durante & Díaz 1996, Raw 2007).

Recently, specimens of both species were obtained from the same trap-nest taken from agroecosystems in Pampean grasslands. This finding, in addition to the morphological and distributional similarity, suggests that both species are the same entity. Thus, in this paper we synonymize *M. santiaguensis* with *M. mendozana* and provide information about the nesting ecology, associated organisms, as well as new geographical and floral records for this species.

Material and methods

Nesting ecology. The study was conducted in an agroecosystem in Hortensia, Pdo. Carlos Casares, Buenos Aires, Argentina (S 35º 56' 44.9", W 61º 11' 43.7"). The main summer crops in this area are soybean (*Glycine max*), maize (*Zea mays*) and, to a lesser extent, sunflower (*Helianthus annuus*) and alfalfa (*Medicago sativa*).

Trap-nests (140 arranged in ten blocks of 14 trap-nests) were placed in November 2009 and inspected monthly until March 2010 when they were removed. The trap-nests consisted of hollow bamboo canes, which were cut so that a nodal septum closed one end of the cane (Aguiar & Garófalo 2004). At each visit the traps with nests were removed and taken to the laboratory. Later, the cells were separated in plastic vials with cotton plugs and numbered from 1 to n (starting by the innermost), and kept until adult eclosion.

Pollen analysis. To explore the taxonomic identity of pollen consumed by larvae during development, once adults were hatched we studied the pollen in the fecal pellets attached to the cocoon. Moreover, in cells in which no adults hatched, we analyzed the pollen mass not consumed by the larvae. To do this, feces were placed in an Eppendorf tube and disaggregated according to conventional techniques (Rust *et al*. 2004) but without acetolyzation.

Later, under microscope, we determined the taxonomic identity of the pollen grains (11 cells from 4 different nests) at the lowest level possible in comparison with pollen reference collection of plants to the study area. Of each sample, at least 500 pollen grains were counted and pollen taxonomic composition of each cell was analyzed as a percentage of the frequency of pollen [% $taxon_i$= (number of pollen grains of $taxon_i$/ total number of pollen grains)*100] (Villanueva-Gutiérrez & Roubik, 2004).

Systematics

Megachile (*Sayapis*) *mendozana* Cockerell, 1907

(Figs. 1–4)

Megachile cornuta Smith, 1879: 78 (*non* Latreille 1805); Cockerell, 1905: 341

Megachile rhinoceros Friese, 1906: 97 (*non* Mocsáry 1892); 1908: 68; Jörgensen, 1909: 215; Vachal, 1909: 15; Moure, 1943: 178.

Megachile mendozana Cockerell, 1907: 50. Replacement name for *M. cornuta* Smith; Jörgensen, 1912: 128; Schrottky, 1909: 267; Cockerell, 1914; 428.

Megachile (*Sayapis*) *mendozana* Mitchell, 1943: 664; Moure, 1943: 178.

Eumegachile (*Sayapis*) *mendozana* Mitchell, 1980: 46.

Eumegachile (*Sayapis*) *santiaguensis* Durante, 1996 (in Durante & Díaz, 1996): 334–336. **[New synonymy]**

Megachile (*Sayapis*) *santiaguensis* (Durante), Raw 2002: 34.

Material studied. New records: ARGENTINA. Buenos Aires. Rivadavia, 1 male, Ea. Trébol Curá, J.P. Torretta & G. Cilla, XII-2006; Carlos Casares, 2 females, Ea. San Claudio, J.P. Torretta & G. Cilla, II-2007; 3 males and 1 female from nests, J.P. Torretta, XII-2010. Córdoba. Roca, 1 male, J.P. Torretta, G. Cilla & N. Montaldo, I-2007. La Pampa. Toay, Ea. Anquilóo, 1 male, J.P. Torretta, XI-2008; 5 females and 1 male, H.J. Marrero I-2009; 2 females, H.J. Marrero II-2009; 1 male, H.J. Marrero XII-2010.

Distribution. In Argentina, this species is found in Buenos Aires, Catamarca, Chaco, Córdoba, La Pampa, La Rioja, Mendoza, Misiones, San Juan, Santa Fe, and Santiago del Estero (Fig. 1). It is also present in Paraguay (Raw 2007) and São Paulo, Brazil (Moure *et al*. 2007).

Comments. All individuals that emerged from the trap-nests (1 female and 3 males) share morphological similarities that support the synonymy. Both sexes have black integument; wings hyaline; costal area, radial cell and distal margin of fore wing dark brown; tegula brown. Pilosity white or pale yellowish. Integument of the head generally coriaceous, small, deep and abundantly punctate, larger on basal area of clypeus. Scutum, scutellum, and axilla with large and abundant punctures. Metasoma with larger, slightly deep and abundant punctures; fifth tergum with irregular and close punctures. Moreover, the distributions of both entities exhibit a broad overlap in Argentina. This overlapping distribution also supports the synonymy proposed in this paper.

Biological observations. Nesting ecology. A total of seven nests of *M. mendozana* were collected in traps. Five nests were gathered in January 2010, while the remaining two in March 2010. The length of the trap-nests used by females of *M. mendozana* were 233.4 ± 21.7 mm (range: 205–258) with apertures of 6.85 ± 0.69 mm (range: 6–8) in diameter. The nests contained from 2-12 cells (4.86 ± 3.29 cells; n= 34). Of the total cells, 20 larvae died during early stages of development and 10 post-defecting larvae were attacked by *Melittobia hawaiiensis* Perkins (Hymenoptera: Eulophidae) (Table 1).

TABLE 1. Nesting period of *Megachile* (*Sayapis*) *mendozana* and emergence of adults. Nesting period is given as period from placement to removal of the traps. Nester associates in block are other *Megachile* species that occupied the same block.

Block	Nest	Nesting period	Cells (n)	Adults emergence (date; position of cell in nest)		Dead offspring		Nesters associates in block
				female	male	larvae mummified	*Melittobia* attack	
III	38	12-XI-09 / 10-III-10	12		1 (22-XII-10; 2)	7	4	*M. gomphrenoides* Vachal *M. jenseni* Friese
VII	93	12-XI-09 / 11-I-10	2			2		*M. gomphrenoides* Vachal *M. jenseni* Friese
XVI	212	12-XI-09 / 11-I-10	4		1 (17-XII-10; 3)	3		M. gomphrenoides Vachal
XVI	213	12-XI-09 / 11-I-10	5	1 (27-XII-10; 2)	1 (22-XII-10; 1)	3		
XVI	214	12-XI-09 / 10-III-10	4			1	3	
XVI	221	12-XI-09 / 11-I-10	4			3	1	
XVI	222	12-XI-09 / 11-I-10	3			1	2	
		Total	34	1	3	20	10	

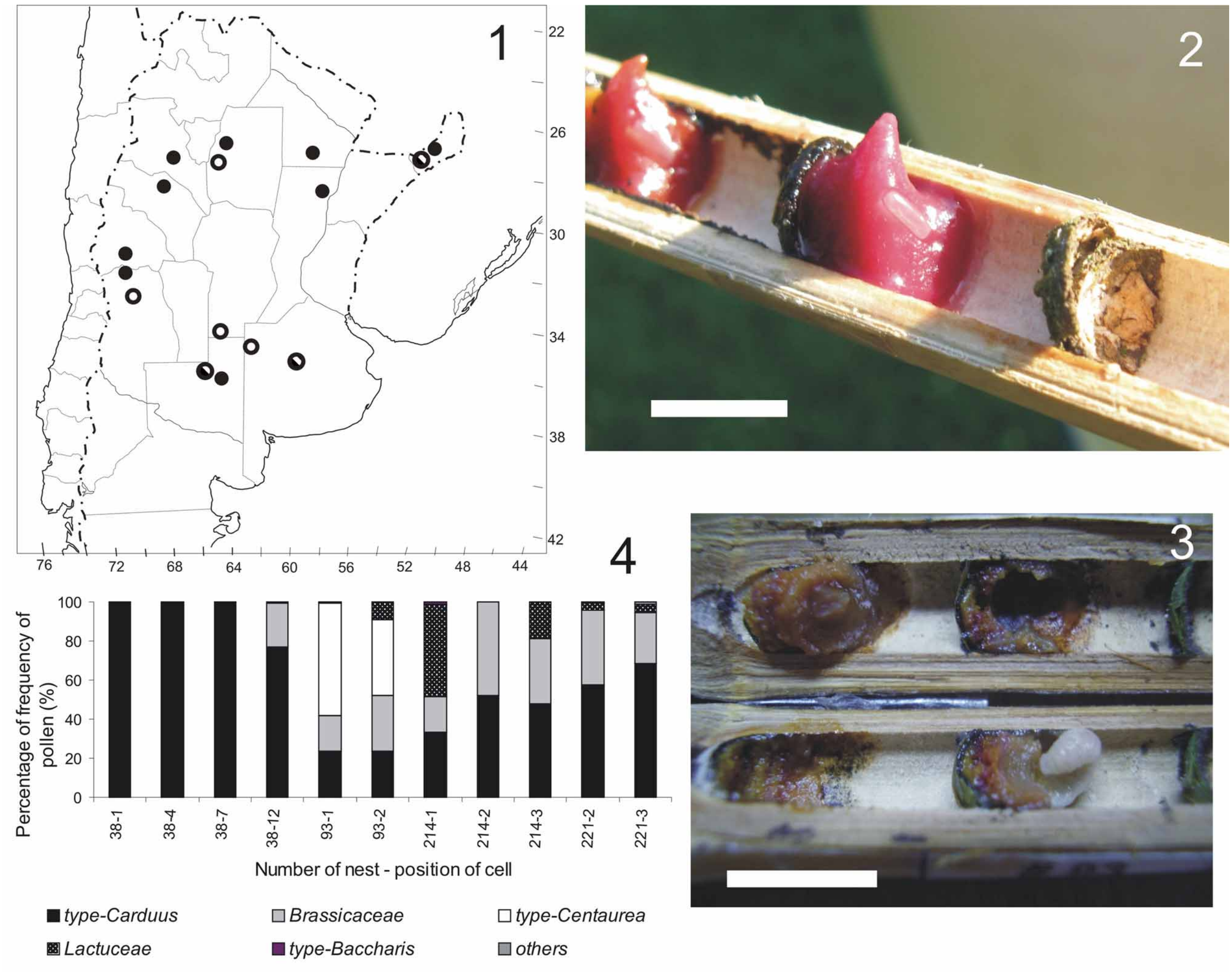
The females of *M. mendozana* construct cells that are separated from each other by partitions and are not surrounded by a leaf/petal/mud envelope (Figs. 2–3). These partitions are formed by small pieces of leaves not sealed to the trap-nest, followed by chewed plant material and earth and small pebbles (2–3 mm of thickness). All the nests were closured with masticated plant material and mud. Pollen masses were moist and sticky, homogenously mixed with nectar, occupying half or 2/5 of the cell volume (Figs. 2–3). The color of the nests provision varied according to the host plant (Figs. 2–3). The eggs were placed on the pollen masses (Fig. 2). Adults of *M. mendozana* hatched between 17 and 27 December 2010 (Table 1).

Pollen analysis. In all cells analyzed, we found 8 pollen types (Fig. 4). Only grains type-*Carduus*, were present in all cells (62.1±29.4%), and in three cells pure pollen (100%) loads were found. Other pollen types found in various cells were type-Brassicaceae (21.3±16.1%, in 8 cells) and type-Lactuceae (7.5 ± 14.1%, in 5 cells). Pollen type-*Centaurea* was only found in two cells but in high percentages (39.2 and 57.2 %) each. The average percentage of Asteraceae pollen was 78.5 ± 28.6%.

Floral hosts. Adults of *M. mendozana* were collected in flowers of the following plant species: *Baccharis pingraea*, *Carduus acanthoides*, *Centaurea solstitialis*, *Cirsium vulgare*, *Helianthus annuus*, and *Senecio pampeanus* (Asteraceae).

Discussion

We synonymized *M. santiaguensis* with *M. mendozana* based on two individuals siblings of different sex obtained from a trap-nest. The presence of both sexes in a single trap nest had already been used to confirm the synonymy of *M. maura* Cresson and *M. carlotensis* Mitchell, and in turn synonymized with *Megachile* (*Melanosarus*) *singularis* Cresson (Genaro 1998).



FIGURES 1–4. *Megachile* (*Sayapis*) *mendozana*. 1. Distribution records for females (●), males (○), and both sexes (◐). 2-3. Trap-nests removed and opened to expose cells. 2. Photographs of live eggs on provisions (cells 3 and 4 of nest # 38). The color of masses pollen is due to pollen of *Carduus acanthoides* and *Cirsium vulgare*. 3. Photographs of early instars 4. Percentage of pollen types found in the provisions and in fecal pellets. Scale lines. Figs. 2–3, 10 mm.

The morphological similarity between individuals of both sexes of *M. mendozana* and *M. santiaguensis*, as well as the overlapping distribution of both entities provide further evidence that support this synonymy. Additionally, while it is possible that a nest can be occupied by two species, in our study area there are not other species of *Sayapis* and have not been recorded from previous pollination studies on sunflowers nor entomophilous flowering plants associated with field margins (Torretta 2007; Torretta *et al*. 2010). Moreover, others species of *Megachile* s.l. that occur in the area and also nest in the trap-nest have cells that differ in their structure or vegetal material utilized (Table 1, Torretta & Durante, unpublished observations).

The nest architecture of *M. mendozana* agrees with the reports on other species of *Sayapis* (Frolich & Parker 1983, and references therein). However, we were unable to observe whether the females of *M. mendozana* use glandular secretions to line nests. Although *M.* (*Sayapis*) *assumptionis* (Schrottky) is a specialist in the selection of nesting sites and uses abandoned cells of *Ptilothrix plumata* Smith in the soil (Martins & Almeida 1994), it shares with other species of the subgenus the use of chewed vegetal matter and mud to close the nest that is built in preexistent cavities.

Although the number of adults obtained is low, the emergence pattern shows that there is one generation per year. The mortality rate observed in the nests of *M. mendozana* was 88.2%. This value is very high compared with other species of *Megachile* that nested in trap-nests from the same site (Torretta & Durante, unpublished observation) and this fact may be due to the lack of protection of the cells in the nests of *M. mendozana*.

Megachile mendozana seems to be oligolectic on flowers of Asteraceae, visiting mainly *Carduus acanthoides* and *Cirsium vulgare* in our study site. The use of pollen of Asteraceae species was also mentioned by *M. pugnata* (Tepedino & Frolich 1982) and *M. assumptionis* (Almeida *et al*. 1997).

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