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SHORT NOTE

Male Sleeping Aggregation of *Melissodes* (*Ecplectica*) *nigroaenea* (Smith, 1854) (Hymenoptera, Apidae, Eucerini) in Brazilian Cerrado

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Abstract

Bee males are sometimes found forming sleeping aggregations on stems of bushes or trees to sleep at night, but there is no complete understanding of the reasons for this behaviour. This note describes the behavior of *Melissodes* (*Ecplectica*) *nigroaenea* (Smith, 1854) males forming temporary sleeping aggregations in dry inflorescences of *Bidens pilosa* L. The sleeping aggregations of *M. nigroaenea* were observed for approximately 15 days in an area of Cerrado, Brasília, DF. During the day *M. nigroaenea* males visit flowers of *Cosmos sulphureus* Cav. near the sleeping aggregations, where the females collect pollen. In the late afternoon, the males return to the sleeping aggregations, where they sleep at night. These data provide new information about the behavior of *M. nigroaenea* males.

The behavior of forming sleeping aggregations on stems of bushes and trees or in the nesting site to sleep at night is characteristic of many species of bees and wasps (Evans & Linsley, 1960; Linsley, 1962; Alves-dos-Santos et al., 2002). Records of these insects forming sleeping aggregations have been made for more than a century, but there is no full understanding of the reasons for this phenomenon (Banks, 1902; Bradley, 1908; Rau & Rau, 1916). However, studies suggest that such behavior may be related to thermoregulation (Evans & Gillaspy, 1964; Linsley & Cazier, 1972), defense against predation (Evans & Linsley, 1960; Alcock, 1998) or the evolution of social behavior (Grassé, 1942).

Bees' sleeping aggregations are usually composed of males because females usually spend the nights inside their nests (Alcock, 1998). Sleeping aggregations can last weeks, months (Evans & Linsley, 1960) or even years when shared by individuals of different generations (Linsley, 1962). Sleeping aggregations of male in the tribe Eucerini (Apidae) have already been reported for different species (Table 1). Here we describe the general aspects of the behavior of *Melissodes* (*Ecplectica*) *nigroaenea* (Smith, 1854) males in two sleeping aggregation in Central Brazil.

Two sleeping aggregations of *M. nigroaenea* males were established for approximately 15 days, between March and April 2018, and observed (about 30 h) in an agroforest on the campus Darcy Ribeiro of the University of Brasília (UnB), Federal District, Brazil (15°45'51.1" S, 47°52'05.4" W), where native plant species are maintained and cultivated in a soil rich in exogenous organic matter and green manure. Two species of Asteraceae – *Bidens pilosa* L. and *Cosmos sulphureus* Cav. – stand out in the place by the occurrence of several species of bees such as *Bombus* (*Fervidobombus*) *pauloensis* Friese, 1913; *Epanthidium tigrinum* (Schrottky, 1905); *Megachile* spp. Latreille, 1802 using the reproductive structures of the plants to sleep. The sleeping aggregations of *M. nigroaenea* were recorded in inflorescences of *B. pilosa*, at about 40 and 60 cm above the ground, and approximately 15 cm between both. The highest number of males was recorded in March when five and ten males, respectively, in the 40 and 60 cm sleeping aggregations were recorded.

The collected specimens (n = 2) were assembled, identified and deposited in the Entomological Collection of UnB (Department of Zoology).

The first males arrived at the sleeping aggregation site around 16:00 h (Figure 1). *M. nigroaenea* males used the mandibles to fix themselves to the dry inflorescences of *B. pilosa*. This way of attaching to the substrate has been observed in many bee species, f. ex. *Coelioxys deplanata* Cresson, 1878; *Melissoptila* aff. *bonaerensis* Holmberg, 1903; *Centris (Paracentris) xanthomelaena* Moure & Castro, 2001 (Linsley, 1962; Mahlmann et al., 2014; Martins et al., 2018). After clinging to the inflorescences, the males used fore and middle legs to find the ideal position to establish in the sleeping aggregation and spend the night (Figure 2). Some males then frictioned the hind legs, concomitantly, sometimes scrubbing them against the sterna or terga. This behavior of scrubbing the legs and the sterna or terga may be related to chemical signaling, being observed also in *Tetrapedia* species (Alves-dos-Santos et al., 2009).

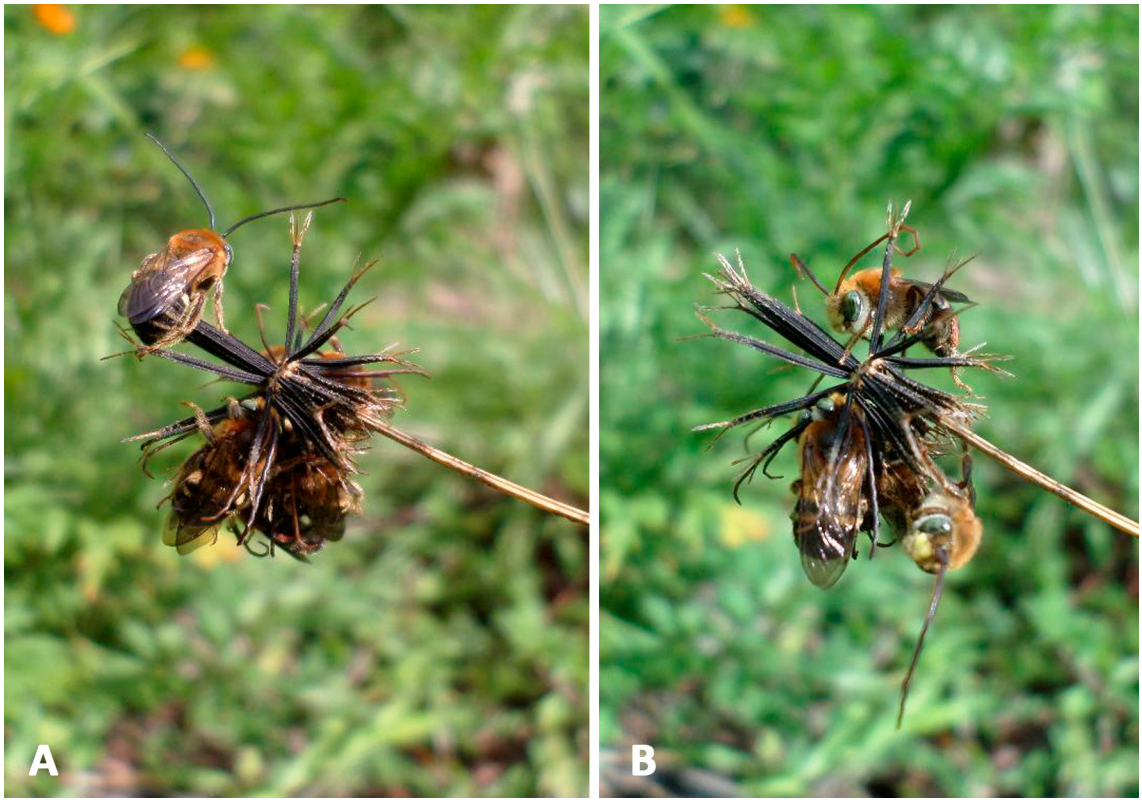

Fig 1. Male sleeping aggregation on dried inflorescence of *Bidens pilosa* 60 cm above the ground (A) *Melissodes nigroaenea* males arriving at the sleeping aggregation. (B) *M. nigroaenea* males trying to find a position in the sleeping aggregation.

Interactions between the *M. nigroaenea* males were registered in some situations, usually due to the arrival of a new individual at the sleeping aggregation, which collided with another male, establishing for a few seconds some contact. These interactions almost always occurred when the last males arrived at the sleeping aggregations, around 17:00 h, and other individuals were already resting. Males left the sleeping aggregations early in the morning, resting individuals were not observed after 07:00 h. However, on two or three occasions *M. nigroaenea* males were recorded returning to their sleeping places and during the day when it was cloudy or raining.

Females of *M. nigroaenea* were observed (about 30 individuals) collecting pollen, mainly between 10:00 and 16:00 h, in flowers of *C. sulphureus* near the sleeping aggregations. *M. nigroaenea* males (n = 4) were often observed ingesting nectar from the flowers of *C. sulphureus*, but of copulations on flowers were not observed (Figure 3).

Fig 2. *Melissodes nigroaenea* males fixed in *Bidens pilosa* through the mandibles at the sleeping aggregation 40 cm above the ground.

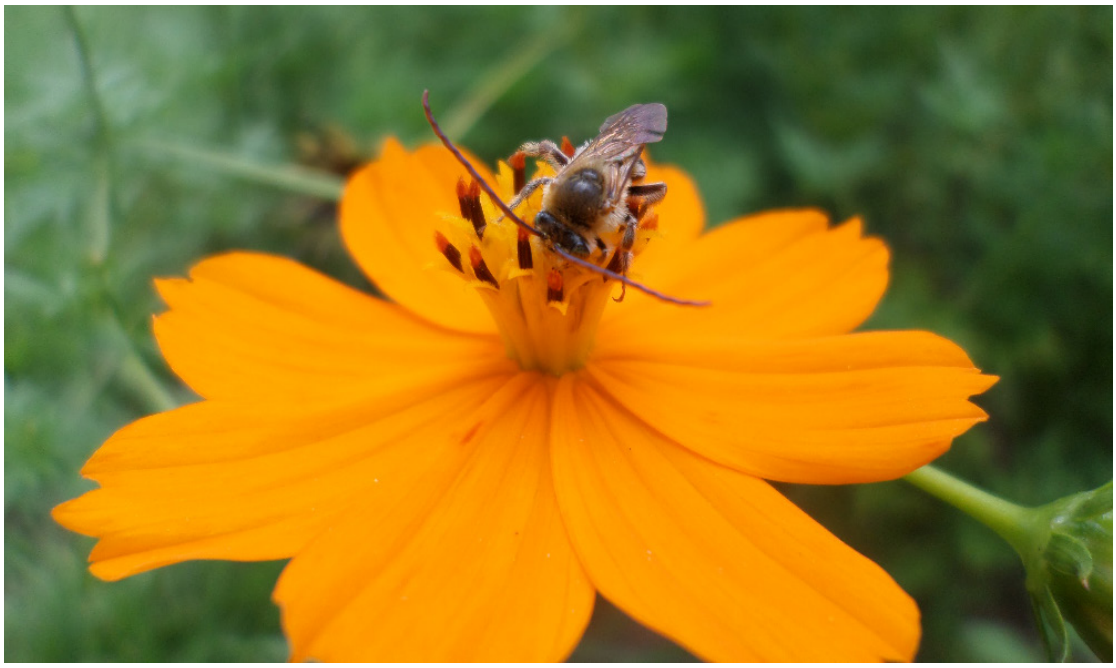

Fig 3. Male of *Melissodes nigroaenea* ingesting nectar in flower of *Cosmos sulphureus*.

According to Chemsak & Thorp (1962), *Melissodes robustior* Cockerell, 1915 males seem to present a preference for sleeping in *Cosmos* sp. flowers, where females collect pollen. Some authors suggest that establishing sleeping aggregations near flowers used by females as a source of floral resources may represent a strategy adopted by males in the search for mates on the next days (Alves-dos-Santos et al., 2009; Pinheiro et al., 2017).

Mahlmann et al. (2014) also recorded a sleeping aggregation formed by *M. nigroaenea* males. The individuals of two Eucerini species – *M. nigroaenea* and *Melissoptila* aff. *bonaerensis* – formed an sleeping aggregation where the individuals remained fixed through the mandibles in dry inflorescences of *Hyptis* sp. (Lamiaceae). Other studies report sleeping aggregations formed by individuals of both sexes (Evans & Linsley, 1960; Starr & Vélez, 2009; Yokoi et al.,

Table 1. Sleeping aggregations records of Eucerini available in the literature.

Species	Substrates	Sex	Reference
Florilegus (*Florilegus*) *condignus* Cresson 1878	On racemes of *Medicago sativa* (Fabaceae)	Male	LaBerge & Ribble (1966)
Gaesochira obscura (Smith, 1879)	Stems of an unidentified species	Unknown	Rau & Rau (1916)
Melissodes (*Ecplectica*) *nigroaenea* (Smith, 1854)	Dried inflorescence of *Hyptis* sp. (Lamiaceae)	Male	Mahlmann et al. (2014)
	Dried stems of *Bidens pilosa* L. (Asteraceae)	Male	Present study
Melissodes (*Eumelissodes*) *agilis* Cress 1878	Stems of an unidentified species	Unknown	Bradley (1908)
	In sunflowers (*Helianthus* sp., Asteraceae)	Unknown	Rau & Rau (1916)
Melissodes (*Eumelissodes*) *denticulata* Smith, 1854	*Verbena stricta* (Verbenaceae)	Male	Mathewson & Daly (1955)
Melissodes (*Eumelissodes*) *robustior* Cockerell, 1915	Inside flower of *Cosmos* sp. (Asteraceae)	Male	Chemsak & Thorp (1962)
Melissodes (*Eumelissodes*) *vernoniae* Robertson, 1902	*Verbena stricta* (Verbenaceae)	Male	Mathewson & Daly (1955)
Melissodes (*Melissodes*) *bimaculata* (Lepeletier, 1825)	Stems of an unidentified species	Unknown	Banks (1902)
	Stems of an unidentified species	Unknown	Rau & Rau (1916)
	Melilotus sp. (Fabaceae)	Unknown	Rau (1938)
Melissodes verroniana Robt.	Stems of an unidentified species	Unknown	Rau & Rau (1916)
Melissoptila aff. *bonaerensis* Holmberg, 1903	Dried inflorescence of *Hyptis* sp. (Lamiaceae)	Males, females	Mahlmann et al. (2014)
Svastra (*Brachymelissodes*) *cressonii* (Dalla Torre, 1896)	Petioles of leaves of unidentified species	Male	Cockerell (1915)
Svastra (*Epimelissodes*) *obliqua* (Say, 1837)	Stems of unidentified species	Male	Rau & Rau (1916)
Svastra (*Idiomelissodes*) *duplocincta* (Cockerell, 1905)	Leaf or stem of *Encelia farinosa* (Asteraceae)	Male	Alcock (1998)
	Leaf or stem of *Calliandra eriophylla* (Fabaceae)	Male	Alcock (1998)
	Leaf or stem of *Ruellia peninsulares* (Acanthaceae)	Male	Alcock (1998)
	Leaf or stem of *Justicia californica* (Acanthaceae)	Male	Alcock (1998)

2016, 2017). However, in the present study only *M. nigroaenea* males were observed in both sleeping aggregations.

Many explanations of the functions of aggregations have been proposed, but are still inconclusive. Sleeping aggregations could represent a strategy to reduce the risk of nocturnal predation, although it could also represent a greater risk of predation as has already been described for stingless bees (Evans & Linsley, 1960; Brown, 1997; Alcock, 1998). Another benefit that sleeping aggregations could provide would be the possibility of elevating the capacity of individuals to thermoregulate, since in the face of a possible predator, the bees could present a minimum ideal temperature to perform the flight activity and consequently escape (Linsley & Cazier, 1972). The hypothesis that males form sleeping aggregations near sources of pollen visited by possible reproductive partners cannot be discarded. Thus, *Cosmos* flowers could serve not only as a source of floral resource but also as a mating site for Eucerini species (Chemsak & Thorp, 1962). Besides sleeping in aggregations, some studies have reported Eucerini males sleeping inside flowers mainly from Cucurbitaceae and Orchidaceae (Hurd & Linsley, 1964; Dafni et al., 1981; Willis & Kevan, 1995; Vereecken et al., 2012; Watts et al., 2013).

There is not yet full understanding of the factors that determine the establishment of sleeping aggregations. However, our observations add new information about the behavior of Eucerini males. Future studies, addressing how this behavior may be related to a possible strategy of defense or sexual selection in solitary bees are needed.

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