Iheringia
Série Zoologia

e-ISSN 1678-4766
www.scielo.br/isz

Museu de Ciências Naturais

Article

Nesting biology of the oil-collecting bee *Epicharis* (*Hoplepicharis*) *fasciata* (Hymenoptera: Apidae) in an urban area of Rio de Janeiro, RJ, Brazil

Felipe Vivallo

Laboratório de Hymenoptera HYMN, Departamento de Entomologia, Museu Nacional/ Universidade Federal do Rio de Janeiro. Horto Botânico, Quinta da Boa Vista, São Cristóvão, 20940-040 Rio de Janeiro, RJ, Brazil. (fvivallo@yahoo.com)

Received 27 June 2020
Accepted 31 August 2020
Published 26 October 2020
DOI 10.1590/1678-4766e2020025

ABSTRACT. Nests of the oil-collecting bee *Epicharis* (*Hoplepicharis*) *fasciata* Lepeletier & Serville, 1828 were studied at the Jardim Botânico of Rio de Janeiro, Brazil. The females constructed their nests in an area of 609 m^2 of mostly sandy flat soil. The nest architecture was relatively simple, with a main tunnel of approximately 30 cm in depth with one or two lateral tunnels ending in a single brood cell. Adult activity lasted approximately 45 days. The females dug the tunnels, constructed the brood cells, collected provisions and laid the eggs in approximately two days. Diapause occurred in the post defecating larval stage, and there was no cocoon. Nest architecture and the morphology of the brood cells are described and illustrated.

KEYWORDS. Anthophila, bionomy, Neotropical Region, nesting architecture, solitary bee.

RESUMO. Biologia da nidificação da abelha coletora de óleo *Epicharis* (*Hoplepicharis*) *fasciata* (Hymenoptera: Apidae) em uma área urbana do Rio de Janeiro, RJ, Brasil. Ninhos da abelha coletora de óleo *Epicharis* (*Hoplepicharis*) *fasciata* Lepeletier & Serville, 1828 foram estudados no Jardim Botânico do Rio de Janeiro, Brasil. As fêmeas construíram seus ninhos em uma área de 609 m^2 de solo plano principalmente arenoso. A arquitetura do ninho é relativamente simples, com um túnel principal de aproximadamente 30 cm de profundidade, com um ou dois túneis laterais terminando em uma única célula de cria. A atividade dos adultos se estendeu por cerca de 45 dias. As fêmeas cavam os túneis, constroem as células de cria, coletam as provisões e depositam os ovos em aproximadamente dois dias. A diapausa ocorreu no estágio de larva pós-defecante e não houve casulo. A arquitetura dos ninhos e a morfologia das células de cria são descritas e ilustradas.

PALAVRAS-CHAVE. Anthophila, bionomia, Região Neotropical, arquitetura do ninho, abelha solitária.

Epicharis Klug, 1807 is one of the genera where females collect oil as floral reward. This Neotropical lineage of solitary bees is distributed from Mexico to Argentina, being especially diverse in South America (Moure *et al*., 2007). Despite the fact that those species are frequently found in museum collections, little is known about their bionomy, especially about their nesting habits. As far as we know, the species of *Epicharis* nest on the ground, and this behavior has been reported for all the species studied of the genus (Gaglianone, 2002, 2005).

The nesting behavior of *E*. (*Hoplepicharis*) *fasciata* Lepeletier & Serville, 1828 was studied by Vesey-FitzGerald (1939) who found a group of nests in Trinidad and Tobago. However, the information cited by this author was restricted to the fragility of the brood cells and the natural enemies that attack the nests, so the nesting biology of this species is almost completely unknown.

This paper presents the results obtained from a study of nests of *E. fasciata*, providing information about the construction process, the nest architecture, the number of brood cells per nest, the appearance of the food, and the presence or absence of cocoon, among others relevant data on the biology of this species.

MATERIAL AND METHODS

A small population of *Epicharis fasciata* was studied during March and April in 2017 and in 2018 at the Jardim Botânico of Rio de Janeiro (JBRJ) (-22°57'59.99"S; -43°12'60.00"W), southeastern Brazil. According to the Köppen-Geiger climate system (Geiger, 1954), the region is identified as "tropical monsoon climate" with monthly mean temperatures above 18°C in every month of the year and a dry season.

The nesting habits of the species were observed directly during the period of activity of the females, which corresponds to the summer (rainy season). Observations were done daily, every hour between 08:00a.m. and 17:00p.m. Two completely finished nests were excavated following the methodology of Marinho *et al.* (2018) to obtain the brood cells. The material obtained was conditioned in plastic boxes

containing blotting paper to accompany the development of the immatures at the Laboratório de Hymenoptera of the Museu Nacional (HYMN)/ Universidade Federal do Rio de Janeiro, Brazil. The architecture of the nests was registered and the brood cells were measured and photographed. The granulometry of the soil where the nests were founded was done using sieves.

RESULTS

Females of *Epicharis fasciata* nested in an uncovered flat soil area with some grass and arboreal vegetation. The area is a triangle of 609 m^2 delimited by gravel trails. During the two periods of observation, an average of 1.5 nests per m^2 was counted. The granulometric analysis showed that the soil chosen by the bees to build the nests is made up of sand (59.89%), silt (20.76%) and clay (19.35%).

The females spent the night inside the nests and began their activities approximately at 08:00a.m. when the temperature rises at the nesting area. They were active throughout the morning, with their activity declining by the end of the afternoon, approximately at 16:00p.m. The females carried out the construction of the nests at any time of the day, although the greatest activity was observed during the morning. Construction began by the cleaning the site: the bees moved backwards while making lateral movements with their hind legs. The construction of the main nest tunnel began with the help of the mandibles and the legs, which were used to clean and move the material out of the tunnel, back and sideways (Fig. 1). After the initial excavation of the tunnel, the female entered and removed the sandy soil towards the exterior forming the tumulus (Figs 1, 2). Periodically, the females performed circular movements to compact the inner walls with their metasoma and hind legs. The time consuming in the nest construction and the food storing was approximately two days (n= 12). During the first day there were constructed the tunnel and the brood cells, and during the second day the females collected provisions, laid the eggs and closed the brood cells. Females were actively constructing and provisioning their nests at the nesting area for about 45 days.

Nest architecture. Nest architecture was fairly simple. This was composed of an entrance surrounded by a relatively small tumulus followed by a tunnel of approximately 30 cm deep, and approximately 2 cm width that ends in one brood cell (Fig. 3). One of the tunnels excavated had no lateral ramifications, while in the other the tunnel was split into two ramifications each ending in a brood cell oriented vertically. The nests were built vertically, although in a sinuous way avoiding stones and roots.

Brood cell morphology. The brood cells had a relatively standardized morphology. They were urn-shaped, with straight lateral walls and with a rounded base (Fig. 4). The wall extended above the operculum by as much as 4 mm, providing a rim to the closure. The operculum was flat, circular and completely sealed, without central projection, similar to that described for *E. flava* (CAMARGO *et al.*, 1975). The wall was rough and dullish on the outside, composed of substrate material, mainly strongly compacted sand. The inner wall of the brood cell was finely coated by a polished and bright dark brown layer (Fig. 5), absent in the operculum. The wall thickness of the brood cell was approximately 0.9 mm, being relatively fragile, despite its appearance. The mean of the additional measurements of the brood cells were: length: 2.8±0.13 cm; maximum width: 1.52±0.03 cm; minimum width: 1.3±0.02 cm; diameter of the operculum: 0.48±0.03 cm. Unfortunately all specimens died in the post defecating stage, so it was not possible to infer any difference on the dimensions of the brood cells related to the sex of the specimens inside.

The provision of the brood cells was a compact and slightly moist mass of orange pollen (Fig. 5) which occupied approximately one third of the brood cell. The pollen was probably mixed with nectar and/or oil from the flowers of any of the species of Malpighiaceae present in the JBRJ. The specific floral sources were not identified.

Figs 1, 2. Construction and nests of *Epicharis* (*Hoplepicharis*) *fasciata* Lepeletier & Serville, 1828 at the Jardim Botânico of Rio de Janeiro:1, female constructing her nest; 2, female inside her nest and another flying in the nesting area.

Biology. *Epicharis fasciata* is a protandric species in which the diapause occurs in the post defecating larval stage. As described for other species of the genus, it does not knit cocoon (ROZEN, 1965; GAGLIANONE, 2002, 2005).

During the period of female's activity, there were observed some males flying in the nesting area, but no copulation attempts were observed. There were also found some specimens of the cleptoparasitic bee *Rhathymus bicolor* Lepeletier & Serville, 1828 (Apidae: Rhathymini) entering the nests (Fig. 6). The females of this species carried out low-altitude flights looking for the entrances of the nests to invade them. In some cases, they entered but left them quickly. It was not possible to determine if this behavior was due the presence of the host female inside the nest or if the nest had no brood cells to be attacked.

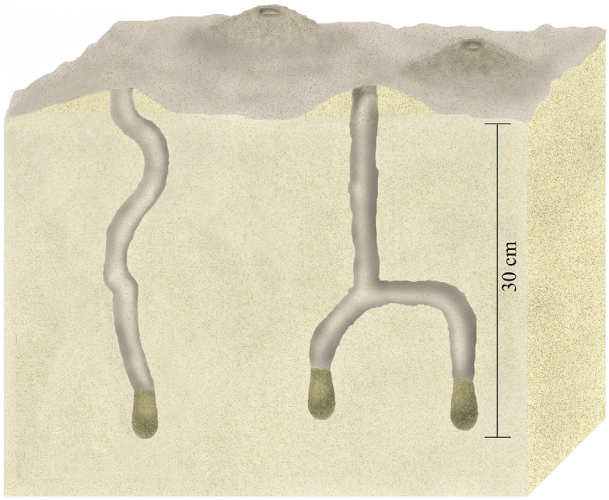

Fig. 3. Nests of *Epicharis* (*Hoplepicharis*) *fasciata* Lepeletier & Serville, 1828 showing the position of the brood cells.

Figs 4, 5. Brood cells and larva of *Epicharis* (*Hoplepicharis*) *fasciata* Lepeletier & Serville, 1828: 4, lateral view (scale bar 1 cm); 5, brood cell with pre-defecating larva eating the pollen mass (scale bar 1 cm).

DISCUSSION

The greater amount of sand in the composition of the soil indicates that the females may not have great difficulty digging the nests. The soil analysis showed that it was mostly sandy, with a relatively high percentage of silt. The proportion between those type of soils (= 80.65% of the sample), provides great impermeability, and subsequently protection to the nest structure and to the brood cells. In addition, the sandy soil as well as the meandering shape of the main tunnel seems to favor the absorption of water during the rains preventing it from reaching the brood cells.

All studied nests were exposed, and it was not observed a preference for building nests in hidden areas or with the entrances covered by vegetation. This feature might help the cuckoo bees as well as other natural enemies to find and attack the nests. Between the species attacking nests of this species, besides *Rhathymus bicolor*, are *R. trinitatis* Cockerell, 1935 and the meloid beetle *Tetraonyx pectoralis* Haag-Rutenberg, 1879 (Coleoptera: Meloidae), both attacking nests of *E. fasciata* in Trinidad and Tobago (VESEY-FITZGERALD, 1939). A female of the mutillid wasp *Pseudomethoca* sp. (Hymenoptera: Mutillidae) was also detected walking in the nesting area. The specimen was followed during a long time, but it was not observed entering the nests (Fig. 7).

It was not possible to recognize a pattern on the nest architecture and the morphology of the brood cells for *E. fasciata*. The number of brood cells found in each of studied nests was different, as well as the nest architecture. However, it can be inferred that the nest is fairly simple and apparently easy to construct, at least in the area studied. It is possible that new studies on the nesting biology will provide additional data that allow or not recognize any pattern, both of the nest architecture and of the brood cells of this species.

Figs 6, 7. Insects associated with *Epicharis* (*Hoplepicharis*) *fasciata* Lepeletier & Serville, 1828: 6, female of the cleptoparasitic bee *Rhathymus bicolor* Lepeletier & Serville, 1828 leaving a nest;7, female of *Pseudomethoca* sp. walking through the nesting area.

The results here obtained somewhat agree with those known for other species of the genus. The ground nesting habit, a well-defined seasonality, diapause in the pre-pupa stage, and the absence of cocoon reinforce the attributes found in species of *Epicharis*.

Acknowledgments. I thank Maria Lúcia Franca Teixeira Moscatelli, JBRJ; Daniel Vidal Pérez, Embrapa Solos, Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Rio de Janeiro, Brazil; Rodrigo de Oliveira Araujo, Juliana Andrade, Diego Marinho, Jairo Ferreira Lopes de Farias and Gisele Palmares Gomes da Paixão, HYMN; Herbeson Martins, Universidade de São Paulo, Brazil; Kevin Williams and the anonymous reviewers for their help. This research was supported by Fundação Carlos Chagas de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ, grant 200.112/2019), Brazil. This research was made under the license nº34609-4 of the Sistema de Autorização e Informação em Biodiversidade, SISBIO, Brazil. This paper is part of the SIGMA project nº21565 MN/UFRJ and contribution number 53 from the HYMN.

REFERENCES

Camargo, J. M. F.; Zucchi, R. & Sakagami, S. F. 1975. Observations on the bionomics of *Epicharis* (*Epicharana*) *rustica flava* (Olivier) including notes on its parasite *Rhathymus* sp. (Hymenoptera: Anthophoridae). **Studia Entomológica 18**(1–4):313-340.

Cockerell, T. D. A. 1935. New bees from Trinidad. **Stylops 4**(1):10-13.

Gaglianone, M. C. 2002. Uma análise comparativa da nidificação das espécies de *Epicharis*. **Anais do V Encontro sobre Abelhas 5**:47-52.

Gaglianone, M. C. 2005. Nesting biology, seasonality, and flower hosts of *Epicharis nigrita* (Friese, 1900) (Hymenoptera: Apidae: Centridini), with a comparative analysis for the genus. **Studies on Neotropical Fauna and Environment 40**(3):191-200.

Geiger, R. 1954. Klassifikation der Klimatenach W. Köppen. **Landolt-Börnstein - Zahlenwerte und Funktionenaus Physik, Chemie, Astronomie, Geophysik und Technik, alte Serie. Berlin 3**:603-607.

Haag-Rutenberg, J. G. 1879. Beiträge zur Kenntniss der Canthariden. I. *Tetraonyx*. **Stettiner Entomologische Zeitung 40**:249-275, 287-314.

Klug, J. 1807. Kritische Revision der Bienengattungen in Fabricius neuem Piezaten systeme mit Berück sichtigung der Kirbyschen Biene familien und Illiger's Bemerk unde zu Kirbys Monographie. **Magazin für Insektenkunde 6**:200-228.

Marinho, D.; Andrade, J.; Araujo, R. O. & Vivallo, F. 2018. A new technique in the excavation of ground-nest bee burrows (Hymenoptera: Apoidea). **Revista Brasileira de Entomologia 62**(1):1-4.

Moure, J.S.; Melo, G. A. R. &Vivallo, F. 2007. Centridini Cockerell & Cockerell. *In*: Moure, J. S.; Urban, D. & Melo, G. A. R. orgs. **Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region**. Curitiba, Sociedade Brasileira de Entomologia, p. 83-142.

Rozen, J. G. 1965. The larvae of the Anthophoridae (Hymenoptera, Apoidea) Part 1. Introduction, Eucerini and Centridini (Anthophorinae). **American Museum Novitates 2233**:1-27.

Vesey-FitzGerald, D. 1939. Observations on bees (Hym. Apoidea) in Trinidad, B. W. I. **Proceedings of the Royal Entomological Society of London 14**(A):107-110.