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Nesting biology of *Pachymenes ghilianii* (Spinola, 1851) (Hymenoptera: Vespidae: Eumeninae: Eumenini) in Panama

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Nesting biology of *Pachymenes ghiliani* (Spinola, 1851) (Hymenoptera: Vespidae: Eumeninae: Eumenini) in Panama

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Abstract. The nesting biology of the potter wasp *Pachymenes ghiliani* (Spinola) (Hymenoptera: Vespidae: Eumeninae) is described based on observations made in the Cerro Turega Hydric Reserve, Penonome, Panama. The collection of building material, the architecture of the nest, the process of building a cell and cell provision with geometrid larvae (Lepidoptera: Geometridae), and the emergence time of the adults are recorded.

Key words. Mud nest, ecology, Geometridae, potter wasp, biodiversity.

Resumen. Se describe la biología de anidación de la avispa alfarera *Pachymenes ghiliani* (Spinola) (Hymenoptera: Vespidae: Eumeninae) en base a observaciones realizadas en la Reserva Hídrica Cerro Turega, Penonomé, Panamá. Se registran la recolección de material de construcción, la arquitectura del nido, el proceso de construcción de una celda, y aprovisionamiento de celdas con larvas geométridos (Lepidoptera: Geometridae), así como el tiempo de emergencia de los adultos.

Palabras clave. Nido de barro, ecología, Geometridae, avispa alfarera, biodiversidad.

Introduction

Our knowledge of the nesting biology of the potter wasps (Vespidae: Eumeninae) is still very fragmentary in details. Iwata's (1976) overview of Eumeninae nesting biology recognized three general categories: excavators, renters, and builders. The validity of this system has been challenged by the polymorphic behavioral plasticity of some genera, such as *Ancistroceroides* Saussure, 1855, *Stenodynerus* Saussure, 1863, *Pachodynerus* Saussure, 1870, etc. (Evans and Matthews 1974; Cooper 1979; Willink and Roig-Alsina 1998), and *Minixi* Soika, 1978 (Hermes et al. 2015), and thus is not a valid character for a natural classification of the subfamily. An important role in eumenine nesting biology may be played by ecological factors (e.g. resource availability) and protection against potential enemies (Hermes et al., 2015). However, Hermes et al. (2013) claimed that two species of *Pirhosigma* (Eumenini tribe) with the uncommon use vegetable matter in the construction of their nests, are exclusively builders (= constructors) of exposed nests.

Pachymenes de Saussure, 1852 is a small neotropical genus of Eumenini, with 18 recognized species, distributed from Mexico to Argentina, with only two species reported from Panama: *Pachymenes novarae* (Saussure) and *Pachymenes ghiliani* (Spinola), the latter being reported from Costa Rica to Argentina (Grandinete et. al. 2015).

Giordani Soika (1990), when treating *Pachymenes ghiliani olivaceus* (Saussure) (currently considered a dark variant of this species), mentioned a nest studied by Bertoni in 1909 in Paraguay, that Giordani Soika suspected to be *Pachymenes orellanae vardy* Giordani Soika (now considered a mere dark variant of that species).

Bertoni (1911) described as *Pachymenes ater* (Saussure, 1852) [*sic.* as *atra*], a pair of very different nests collected in Paraguay between 1909 and 1910: one consisted of a series of stacked discoid cells forming a cylindrical structure along a very fine twig, and the other was a globular structure pierced by a sharp twig (similar to the nests of *Sceliphron fistulare* (Dahlbom) as shown in Compagnucci and Roig-Alsina (2008) (Figure 4). Later Bertoni (1918) identified the first nest specimen (referenced and labeled “2620” by Bertoni) as *Pachymenes velutina* Ducke, currently a synonym of *P. ghiliani* (appendix S2 of Grandinete et al. 2015). However, based on the description of the clypeus given by Bertoni (1918) and examination of the specimens by the second author of this article (BRGB), the correct identification is *Pachymenes orellanae* (Schulz, 1905).

The second nest described by Bertoni (1918) as belonging to *Pachymenes ater*, was identified based on the structure of the clypeus. The specimens are not numbered in the additional half-dozen nests present in the collection of Bertoni and there are several specimens with labels indicating “Spheroid nest.” But we infer that this second nest of Bertoni (1918) fits well with the current concept of *Pachymenes ater* Saussure.

Therefore, although *Pachymenes ghiliani* is a common and widely distributed species, it remains unknown how flexible are its nesting habits. In this article we present details of the nesting biology *Pachymenes ghiliani*, including the process of building a cell, the architecture of the nest, and the emergence time of the adults.

Materials and Methods

Biological and ecological observations were carried out inside the forest of the Cerro Turega Hydric Reserve, Penonome, Coclé prov., Panama (05°89'02.9"N, 09°52'85.8"W), 2-4 June 2017 (Fig. 1). Along a linear transect of approximately 1 km, we checked for wasp nests along tree bases, branches, the undersides of leaves in trees and shrubs up to 1.5 m above ground level, in dirt road slopes, and above rocks, and took pictures of the area. It was possible to detect and collect an active mud nest by following an adult female potter wasp. The completed nest was collected and placed in a hatching chamber and maintained in the laboratory at an average temperature of 26°C and a relative humidity of 82% for the larvae to continue their development. All the wasps that emerged from the nest were mounted on entomological pins and deposited into the National Reference Collection of the G B. Fairchild Invertebrate Museum of the University of Panama.

Results and Discussion

In the Cerro Turega transect (Fig. 2), we observed, at 8 a.m., one female *Pachymenes ghiliani* (Spinola) (Vespidae: Eumeninae) collecting small sand and earth crystals with her mandibles, this material mixed with regurgitated water produced the mud used for her nest construction (Fig. 3). The female then flew to a nearby shrub, where on the underside central rib of a leaf, she was building the fourth cell of a mud nest that already had three complete cells (Fig. 4). This nest was kept in observation until 5 p.m. that same day. It took about three hours to finish the fourth cell, as the female made different length trips to the nearby source of building materials (Fig. 5). The rest of the day was devoted to collecting Geometridae larvae (Lepidoptera) to provision the fourth cell (Fig. 6). Finally, the female wasp sealed the cell with mud.

The entire nest measured approximately 25.4 mm, each of the four cells was ovoid and distinctly recognizable from the outside (Fig. 6). Cells had an average diameter of 5.89 mm and length of 16.20 mm, the supply hole (before sealing) measured 6.19 mm. The latter indicates to us that the geometrid larvae captured as prey should have the same or a smaller maximum body diameter. Each cell contained four to five paralyzed geometrid larvae and a single larva of *P. ghiliani* feeding on them.

In the laboratory, after 23 days, an adult female emerged from cell 1 (Fig. 7); then 5 days later an adult male emerged from cell 3 (Fig. 8, 9, 10). No adults emerged from pupae present in cells 2 and 4 after two more weeks. We have estimated that the first cell was built on May 31, 2017, and the life cycle from egg hatching to emergence of an adult (Fig. 8, 9, 10) takes approximately 28 days.

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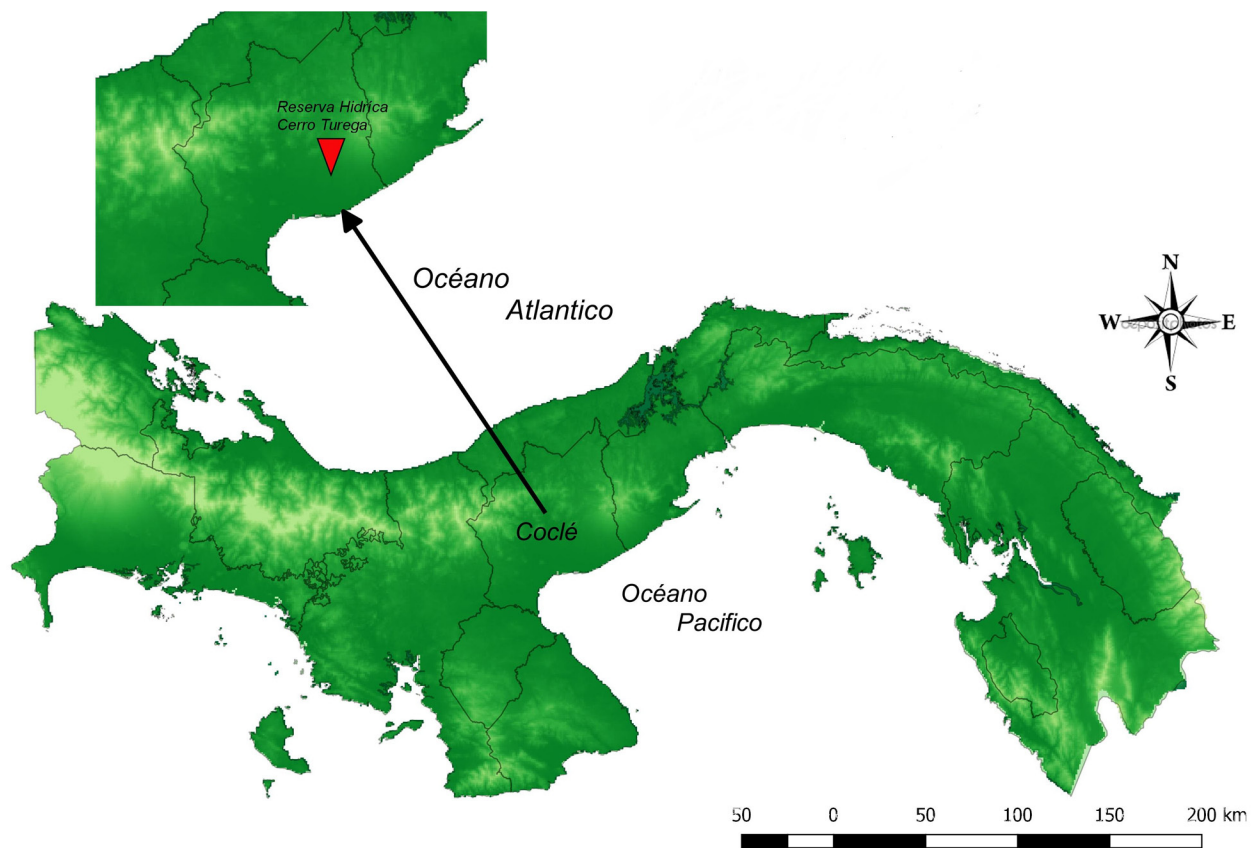
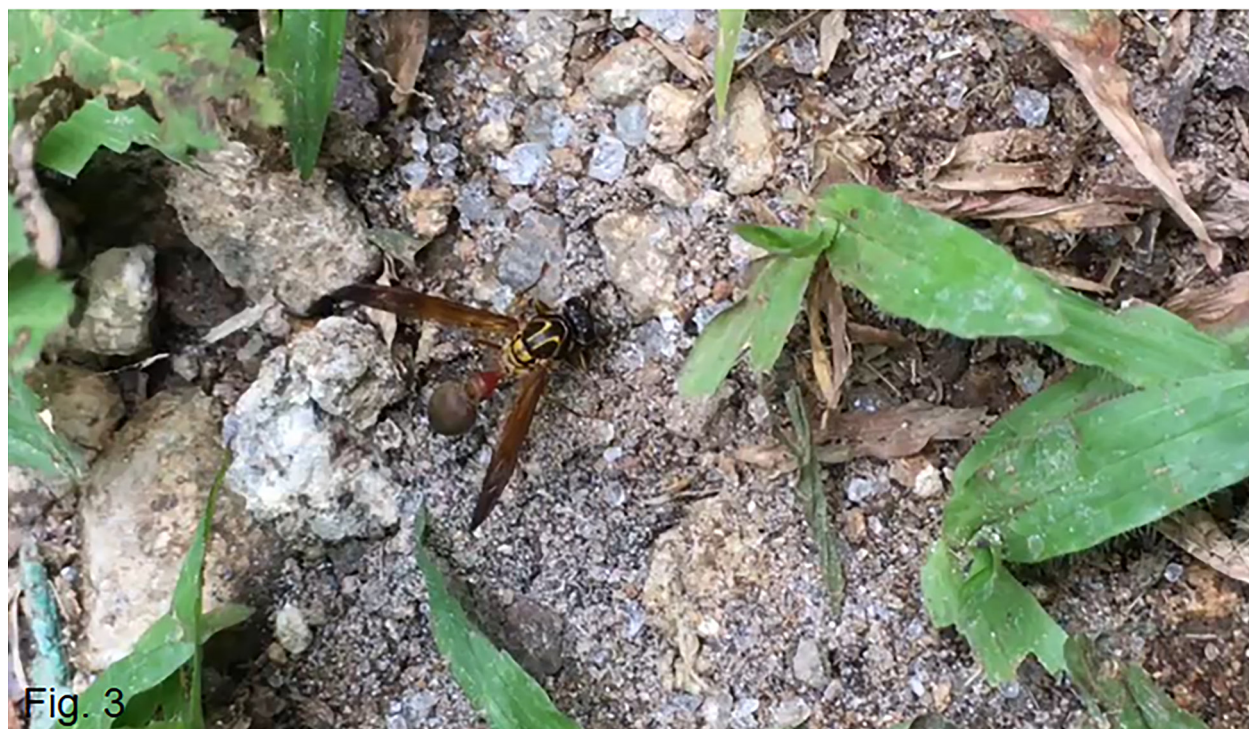
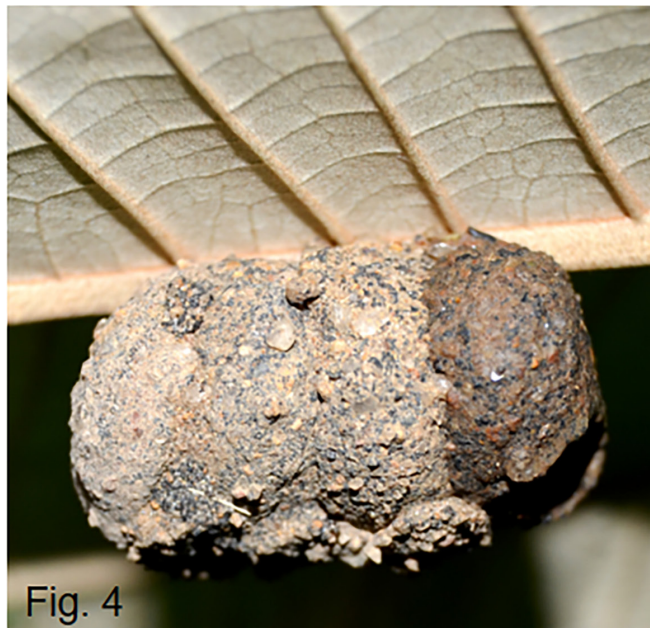


Figure 1. Coordinates of the sampling site (Cerro Turega Water Reserve).



Figures 2–3. Behavior of *Pachymenes ghilianii*. 2) Trail in Cerro Turega. 3) Female of *P. ghilianii* collecting dirt from the trail.



Figures 4–6. Behavior of *Pachymenes ghiliani*. **4)** Nest built on the underside of a leaf. **5)** Female *P. ghiliani* (Eumeninae) building the nest. **6)** Female of *P. ghiliani* supplying nests with lepidopteran larvae.



Fig. 8



Fig. 9



Fig. 10

Figures 7–9. Behavior of *Pachymenes ghilianii*. **7)** Female of *P. ghilianii* emerged from cell 1. **8)** Male of *P. ghilianii* emerged from cell. **9)** Side view of *P. ghilianii* (Eumeninae) hatched from the Cerro Turega nest.

