First remarks on the nesting biology of *Hypodynerus andeus* (Packard) (Hymenoptera, Vespidae, Eumeninae) in the Azapa valley, northern Chile

Felipe Méndez-Abarca[1], Enrique A. Mundaca[2] & Héctor A. Vargas[3]

[1]Departamento de Biología, Facultad de Ciencias, Universidad de Tarapacá, Casilla 6-D, Arica, Chile. acuariumecozoo@hotmail.com
[2]Universidad Católica del Maule, Facultad de Ciencias Agrarias y Forestales, Escuela de Agronomía, Casilla 7-D, Curicó, Chile. emundaca@ucm.cl
[3]Departamento de Recursos Ambientales, Facultad de Ciencias Agronómicas, Universidad de Tarapacá, Casilla 6-D, Arica, Chile. havargas@uta.cl

ABSTRACT. First remarks on the nesting biology of *Hypodynerus andeus* (Packard) (Hymenoptera, Vespidae, Eumeninae) in the Azapa valley, northern Chile. Some aspects about the nesting biology of the potter wasp *Hypodynerus andeus* (Packard, 1869) are reported for the first time. Observations were carried out at the Azapa valley, coastal desert of northern Chile. A total of sixty nests were collected and examined, each composed by 1–14 cells, most of them found attached to concrete lamp posts. The only preys recorded in the cells were Geometridae (Lepidoptera) caterpillars and the presence of the parasitoid *Anthrax* sp. (Diptera, Bombyliidae) was also recorded. A number of arthropods belonging to different groups, mainly spiders, were found occupying empty nests.

KEYWORDS. Araneae; *Centris mixta*; *Macaria mirthae*; Megachilidae; *Monobia*.

RESUMO. Primeiras observações sobre a biologia da nidificação de *Hypodynerus andeus* (Packard) (Hymenoptera, Vespidae, Eumeninae) no vale de Azapa, norte do Chile. Alguns aspectos da biologia da nidificação da vespa *Hypodynerus andeus* (Packard, 1869) são registrados pela primeira vez. As observações foram conduzidas no vale de Azapa, deserto litoral do norte do Chile. Sessenta ninhos foram coletados e examinados, cada um composto por 1–14 células. A maioria dos ninhos estava aderida a postes de concreto. As únicas presas registradas nas células foram larvas de Geometridae (Lepidoptera). Um parasitóide, *Anthrax* sp. (Diptera, Bombyliidae), foi também registrado. Vários artrópodes, principalmente aranhas, foram encontrados utilizando ninhos vazios.

PALAVRAS-CHAVE. Araneae; *Centris mixta*; *Macaria mirthae*; Megachilidae; *Monobia*.

Eumeninae, also known as potter or mason wasps, are primarily solitary hunters, with some primitively social species (West-Eberhard 2005). Nesting habits are variable in this subfamily. Some wasps utilize pre-existing or natural cavities, excavate holes in the ground or build their own nests sticking them to different types of substrates (Boesi *et al.* 2005). Mud is typically used by eumenine for nest construction, but some species use chewed leaves (Bohart & Stange 1965). In general, the female deposits its eggs and stores preys inside the nests. These preys are utilized as sources of food for the wasp's larva (Ittyeipe & Taffe 1982; Chiappa & Rojas 1991; Camillo 1999; Budrienè 2003; Boesi *et al.* 2005; Buschini & Buss 2010). These active hunting wasps are considered to be important components for natural and anthropic ecosystems, as they interact with a wide range of organisms (Matthews & González 2004). Occurrence and abundance of potter wasps have been related to the availability of suitable substrates to build their nests. Prey availability also plays a crucial role in determining the occurrence and abundance of potter wasps, as their presence allows satisfying the nutritional requirements of the larval stages. In this context, feeding specificity becomes highly relevant for larval development. Some Eumeninae are highly specific, hunting preys of one or few species of the same genus. On the other hand, some species are generalists, hunting larvae of different orders (Budrienè 2003). In general, nests built by potter wasps persist even after the adults or parasitoids have emerged, thus it is common to find spiders and others arthropods utilizing these empty cells as shelters (Pérez D'Angello 1968; Matthews & González 2004).

Hypodynerus de Saussure, 1855 is a Neotropical genus of Eumeninae, with a geographic distribution mostly associated to the Andes range (Carpenter & Garcete-Barrett 2002). A total of thirty species have been recorded in Chile (Barrera-Medina 2011). Although *Hypodynerus* is a widely distributed genus in Chile, spreading from the extreme north of the country to the Magallanes Region, the only information about nesting biology correspond to species occurring in the central-south area of the country (Claude-Joseph 1930; Pérez D'Angello 1968, 1974, 1991).

Hypodynerus andeus (Packard, 1869) (Fig. 1) is distributed in Ecuador, Peru and Chile (Willink 1970). In the last country, *H. andeus* is the most conspicuous species of Eumeninae present in the coastal valleys of the northern area.

The aim of this study is to describe and illustrate for the first time the nest of *H. andeus*. We also give details of the presence and composition of preys, parasitoids and other arthropods associated to the cells of this potter wasp.

Fig. 1. Adult of *Hypodynerus andeus* carrying a *Macaria mirthae* larva, perching on a *Citrus* branch.

MATERIAL AND METHODS

Observations were carried out in the Azapa valley (18°34'S, 70°00'W), Arica Province, northern Chile, between July and December 2010. This location is a highly disturbed area, where most native vegetation has been replaced by agricultural lands which have been put to intensive use. This situation is commonly observed in most of the coastal desert valleys of northern Chile (Luebert & Pliscoff 2006). Nests were located, photographed, measured and removed from the substrate to examine their content. All material removed from each cell was taken to the Laboratorio de Entomología, Departamento de Recursos Ambientales, Facultad de Ciencias Agronómicas, Universidad de Tarapacá, to be analyzed. Quantification and identification was carried out under a stereomicroscope. Cell measures were made utilizing a graduated cylinder with the stereomicroscope. Identifications were based on comparisons with voucher material in the Colección Entomológica, Universidad de Tarapacá (IDEA).

RESULTS AND DISCUSSION

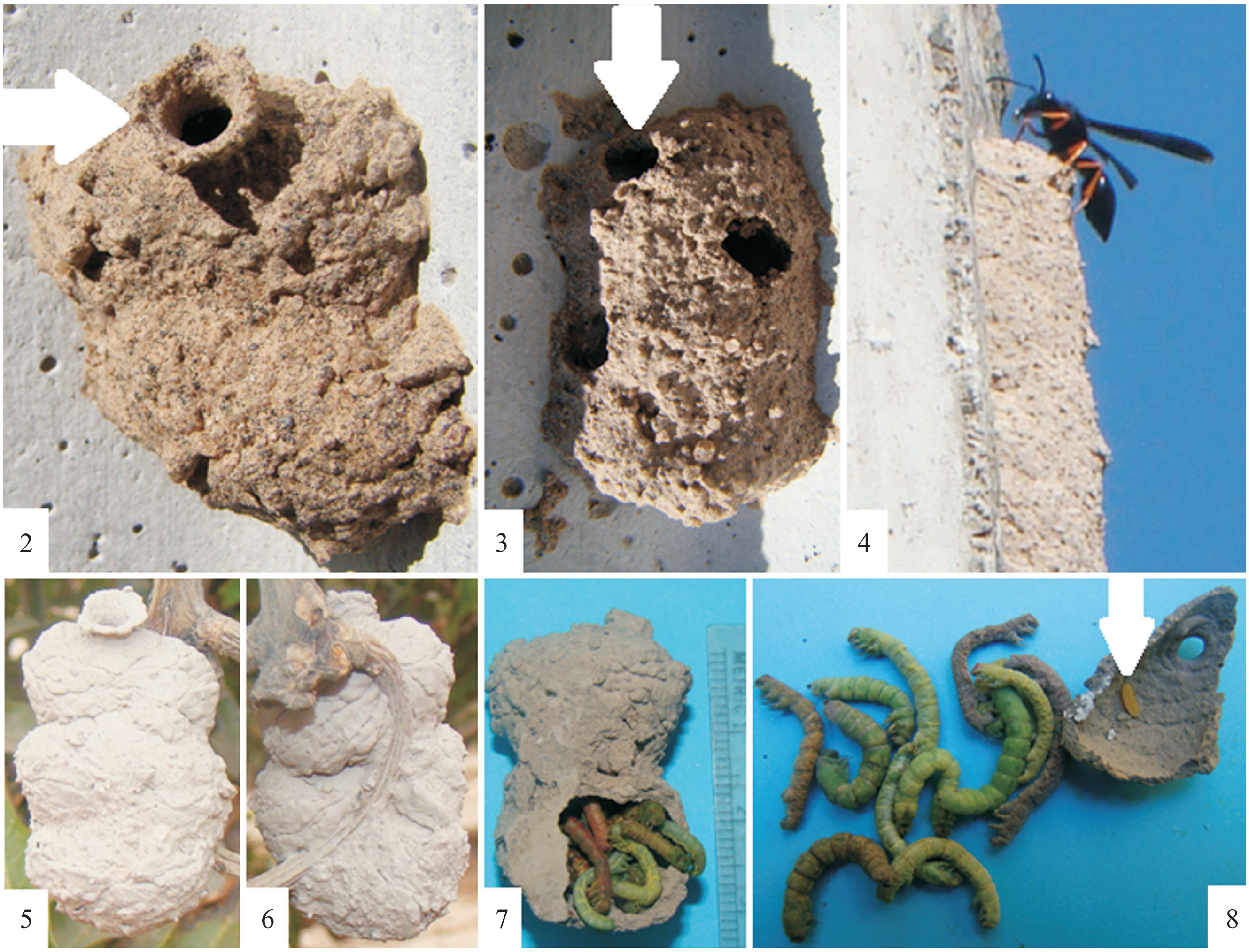
Substrate. We analyzed the substrate of the 60 nests collected in the field. A total of 57 were attached to concrete posts (Figs. 2–4), and the others on a fence, rock and a mango tree branch (Figs. 5, 6). Previous records indicated that other species of the genus nest on plant stems (Pérez D'Angello 1974, 1991). There are species of Eumeninae which attach their nests to human-built structures (Camillo 1999; Matthews & González 2004; Matthews & Matthews 2009). The utilization of this type of substrate becomes important for the establishment and nidification of potter wasps in areas of high human intervention, providing potential habitats for them.

Nest. The examined nests ranged from 1 to 14 cells distributed vertically. The wasp adds cells from the bottom to the top of the nest, once at the time, resulting in a gradient of older individuals occupying lower cells and younger individuals occupying upper cells. This group of cells (which together create a nest) is covered by an extra layer of mud to provide extra mechanical resistance to the nest. This type of additional layer of mud has been reported before for the Neotropical species *Brachymenes dyscherus* Saussure, 1852 (Camillo 1999) and the Australian, *Abispa ephippium* (Fabricius, 1775) (Matthews & Matthews 2009).

Cell. Ellipsoidal dome-like shaped (25 × 13 mm); main axis horizontally oriented; entrance orifice located by the cell's center, slightly displaced towards the upper part, average diameter 3.24 mm (range 2.89–3.60 mm). A funnel shaped structure is built by the female around the entrance orifice (Fig. 2); average diameter at apex of this structure 8.64 mm (range 7.2–10.2 mm). Building this funnel-like structure around the entrance orifice of the cell plays an important role in the protection of the cell during the prey filling process carried out by the female (Matthews & Matthews 2009). This funnel-like structure can be relatively small sized when compared to the cell's size, such as in the case of *H. andeus* and *Zeta argillaceum* (Linnaeus, 1758) (Matthews & González 2004). In some cases this structure can reach sizes even larger than the cell itself, as in the Australian species *A. ephippium* (Matthews & Matthews 2009). Once the cell has been filled with preys and oviposition is done, the funnel-like structure is removed and the entrance orifice is sealed with mud by the female. The adult emerges leaving a circular orifice in one of the distal sides of the cell (Fig. 3). The same orifice is utilized by other arthropods to enter the empty cell.

Content of the cells. We examined a total of 277 cells (Table I). Out of this, 54 contained immature of *H. andeus* in different stages of development. Thirty-two cells were empty and 191 were occupied by other arthropods. Nineteen were occupied by an unidentified species of Megachilidae (Hymenoptera). Spiders occupied 166 cells and one cell was occupied by *Monobia* sp. (Vespidae, Eumeninae). Two cells were occupied by adults of *Centris mixta* Friese, 1904 (Hymenoptera, Apidae) parasitized by an unidentified species of Diptera. Finally, three cells were found to contain adults and pupae of *Antrax* sp. (Diptera, Bombyliidae). The number of species associated with cells of *H. andeus* is little when comparing with other *Hypodynerus* from central-south Chile (Claude-Joseph 1930; Pérez D'Angello 1968). It is probably due to the overall lower diversity in the hyper-arid coastal desert of northern Chile.

Preys. The only preys detected in the cells were larvae of the Lepidoptera family Geometridae (Figs. 7–8), with 33–40 larvae per cell. The composition of preys found in the cells could be evidence of a potential feeding specialization of *H. andeus*. Pérez D'Angello (1968) has indicated unidentified micromoths as preys of *Hypodynerus lachesis* (Lepeletier, 1841) in central Chile. The association with Geometridae larvae has been reported before for other species of Neotropical



Figs. 2–8. Nests and preys of *Hypodynerus andeus*. 2) Nest of *H. andeus* on a concrete post, arrow indicates the entrance orifice to the cell; 3) Nest of *H. andeus* on a concrete post, arrow indicates the emergence orifice of the adult; 4); Upper part of a *H. andeus* nest on a concrete post seen laterally plus a recently emerged adult from one of the lower cells; 5) Front view of a *H. andeus* nest adhered to a mango branch and 6) Rear view of the same nest; 7) Rear view of a *H. andeus* removed from a concrete post; 8) Content of a *H. andeus* cell partially filled with preys, arrow shows an egg of *H. andeus*.

Table I. Details of content of cells of *Hypodynerus andeus* (Packard) collected in the Azapa valley, Arica, northern Chile.

Content of the cell	Number of cells
Hypodynerus andeus (Vespidae), egg, larva, pupa	54
Anthrax sp. (Diptera: Bombyliidae), pupa, adult	3
Megachilidae (Hymenoptera)	19
Monobia sp. (Hymenoptera: Vespidae) adult	1
Centris mixta (Hymenoptera: Apidae) parasitized adult	2
Araneae	166
Empty cells	32
Total	277

Eumeninae (Matthews & González 2004), although the diet of some potter wasps can include also other insect families of Coleoptera and Lepidoptera (Ittyeipe & Taffe 1982; Chiappa & Rojas 1991; Camillo 1999; Sears *et al.* 2001; Budrienè 2003). Once the geometrid larva is captured by the female, it manipulates the larva with the mandibles and prothoracic legs (Fig. 1) carrying it afterwards to the nest. None of the larvae collected reached the pupal stage during the sampling period; therefore, we were not able to obtain any adult moths for further taxonomic identification. However, based on the external morphology of the larvae collected, three morphospecies were identified. On the other hand, based on comparisons with larvae rearing carried out previously in the same location, we identified *Macaria mirthae* Vargas, Parra & Hausmann, 2005 (Fig. 1). This was the most frequently captured prey by *H. andeus* with approximately 50% of the total recorded larvae belonging to this species. Larvae of this geometrid moth occur normally on the native shrubs *Acacia macracantha* Humb. & Bonpl. ex Willd. and *Geoffroea decorticans* (Gillies ex Hook. & Arn.) Burkart (Vargas *et al.* 2005). It is common to observe females of *H. andeus* surveying for preys around the branches of these two species.

In a nest of *H. andeus* previously collected in the same locality we found one of the cells with a *H. andeus* egg and nine geometrid larvae, as the female was still in the process of filling the cell with preys. Eight of these larvae were *M. mirthae* and one larva belonged to an unidentified species which pupated and subsequently a male adult was obtained in the laboratory and was identified as *Cosmophyga cortesi* Vargas, 2008, whose immature stages and host plants are unknown (Vargas 2008). This adult of *C. cortesi* did not reach to expand its wings, although more than 24 hours passed from its emergence until its death. Although the record of *C. cortesi* could be the result of a mistake made by the female of *H. andeus* while collecting preys, we could speculate the existence of prey specificity, or at least preference, due to the proportionally high number of individuals of *M. mirthae* collected by *H. andeus.*

In order to obtain more detailed knowledge of the prey preferences of *H. andeus* in the coastal valleys of northern Chile it is necessary to know the external morphology of the geometrid larva in the study area. This will allow, in the future, to accurately identifying the larvae captured by this wasp. The mechanisms that determine such prey preferences in *H. andeus* still remain unknown. There are at least ten species of Geometridae which are commonly collected in the Azapa valley (*e.g.*: Vargas 2007, 2008). It is interesting to notice that only three morphospecies are regularly collected in the nests of *H. andeus*, based on results here reported. A factor that could be determining the prey range of *H. andeus* is the time of larval activity. This could explain the lack of records of at least two species of night feeding larvae, *Chrysmopterix undularia* (Blanchard, 1852) and *Pero obtusaria* Prout, 1928, which would be free of predation from the diurnal *H. andeus* (Vargas *et al.* 2010; Vargas 2011).

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