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On the observation of nesting of *Delta dimidiatipenne* (de saussure, 1852) (Hymenoptera: Vespidae: Eumeninae) from North-West Algeria

Abdenour Kheloufi

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Abstract: The present study records the first observation of a female *Delta dimidiatipenne* constructing its nest in Oran (NW-Algeria). The nest construction and developments thereafter were monitored every three days from July to September 2022 (70 days). Ultimately four female wasps were successfully emerged. This first record will be useful for future studies on the distribution, behaviour, ecology and conservation in this semi-arid region.

Key words: distribution, semi-arid, Algeria, *Delta dimidiatipenne,* nesting, first report

Introduction

The *Delta* genus, which comprises approximately 50 species and numerous subspecies, falls under the subfamily Eumeninae of the Vespidae family within the order Hymenoptera (Ebrahimi and Carpenter 2008). *D. dimidiatipenne* (de Saussure, 1852), is ecologically an interesting species which has been observed at diverse geographic regions, including regions such as Afghanistan, Algeria, Cambodia, Chad, China (including Hong Kong), Djibouti, Egypt, Eritrea, Ethiopia, Hawaii, India, Indonesia, Iran, Israel, Jordan, Madagascar, Malaysia, Mauritania, Morocco, Nepal, New Guinea, Niger, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, South Africa, Spain, Sri Lanka, Sudan, Syria, Taiwan, Tajikistan, Thailand, the Canary Islands, the United Arab Emirates, Tunisia, Turkey, Turkmenistan, Uganda, Vietnam, Western India, and Yemen, mainly in desert habitats (Lauterbach and Latsch-Lauterbach 2007; Srinivasan and Kumar 2010; Nguyen et al. 2014; Rafi et al. 2017; Hamzavi et al. 2019; Segoli et al. 2020).

Potter wasps, such as those in the *Delta* genus, exhibit a unique nest-building behaviour whereby the female constructs the nest from a combination of sand or mud and saliva, resulting in a moist clay material (Bodlah et al. 2011). Typically, these nests adhere to walls or rocks and may feature a slightly elevated edge around the entrance. After the completion of the nest, the female places a solitary egg inside and suspends it from the ceiling. Subsequently, the female fills the nest with numerous caterpillars, serving as nourishment for the larva's growth within the cell (Fateryga and Ivanov 2009). Adults of these wasps, much like other solitary species, primarily feed on nectar (Bodlah et al. 2012). Few ecological studies on prey collection, forging behaviour and parasitoids of *D. dimidiatipenne* were studied in Israel (Segoli et al. 2020; Leduc et al. 2022; Johnson et al. 2023). Barring these the nesting behaviour of *Delta* species remains significantly understudied.

There is some existing information available on the reproductive biology of *D. dimidiatipenne*, as documented by (Matthews & Matthews 2018) and (Ahmad et al. 2020). Additionally, Bodlah et al. (2012) and Habib et al. (2017) have provided some brief insight into the nesting behaviour of this wasp. However, research on *D. dimidiatipenne* in Algeria is quite scarce, with only a few old surveys on the overall distribution of Hymenoptera conducted by André (1884),

Buysson (1908), and Nadig (1933). According to these studies, the distribution of this family encompasses the southern region of Algeria, but no observations have been reported in the North of the country. The aim of this research is to record the first nesting of *D. dimidiatipenne* in north-western Algeria and to provide a preliminary analysis of its nesting habits, along with a general description of the emerged adult wasps.

Materials and methods

Study area

Oran is a remarkable Mediterranean city situated on the southern coast of the Allegro Provence basin in north-western Algeria, approximately 432 km west of the capital, Algiers. Encompassing an area of 212 100 hectares, it is positioned at 35°41'28'' N latitude and 0°38'30'' W longitude. Oran's average altitude is approximately 60 m. Oran is characterized by its extended, hot, and humid summers with minimal rainfall. The climate in Oran is warm and temperate, with more significant rainfall occurring during the winter as opposed to the spring. Overall, Oran's climate is classified as semi-arid (Benammar, 2016).

Observation survey

On 10th July 2022, a nest belonging to *D. dimidiatipenne* was discovered in a corner of an abandoned house located on a farm in the municipality of Misserghin (Oran, Algeria). The location of the farm is (Latitude: 35°35' N; Longitude: 0°45› W and 120 m a.s.l.) (Fig. 1). At the time of discovery, the female wasp was observed constructing the fourth cell of the nest at 5:00 pm (UTC+1). Photographic records of the wasp's activities were taken using a Nikon CoolPix P610 camera. Subsequent inspections of the nest were made every three days until 18 September 2022 when the adult wasps emerged.

Two out of the four wasps were collected and preserved in the Department of Ecology and Environment collection at the University of Batna (Batna, Algeria). It is noteworthy that the female wasp was not observed after sealing her nest.

Fig. 1: Habitat of *Delta dimidiatipenne* (de Saussure, 1852) in Oran (NW-Algeria): A - General view of the farm; B - Arrival of the female at the nest. (Photo B: A. Kheloufi)

The climatic data presented in Tab. 1 were sourced from the World Climate Data Tutiempo (www.tutiempo.net) for the year 2022. These data originate from the meteorological station 604900DAOO (Airport Sénia, Oran, Algeria), positioned at 35.63° N latitude, -0.6° W longitude, and an altitude of 90 m above sea level.

Tab. 1: Average climatic data values recorded in Oran, Northwest Algeria during 2022.

Climatic data	Year 2022 (364 days)
Annual average temperature	19.4 °C
Annual average maximum temperature	25.8 °C
Annual average minimum temperature	13.6 °C
Highest temperature	13th August (42.2 °C)
Annual average humidity	67%
Total annual precipitation	188.95 mm
Number of rainy days	64
Number of snowy days	0
Number of hail days	0

Results and discussion

Delta dimidiatipenne can be distinguished by its reddish head, adorned with black markings extending from the rear of the eyes at the top of the head to the back of the neck. The thorax is predominantly black, with red spots on the second segment and on the upper portions of the third and final segments. The characteristic narrow waist, common in solitary wasps, results from the fusion of the thorax and the first segment of the abdomen. The abdomen is mostly black, with a distinctive red band just beyond the waist. Rusty wings with gray-brown tips, possibly displaying a purplish hue, further characterize this species. Additionally, the antennae typically feature black tips. Compared with its female counterpart, the male appears the same, with the exception that it is slightly smaller and slenderer than the female, and it also has a yellow spot on its forehead between its eyes. According to various sources (Dvořák & Castro 2007; Kumar & Sharma 2014), females range in size from 24 to 27 mm, while males are typically 22 to 25 mm long.

Of the four specimens of *D. dimidiatipenne* examined, the average body length was 28 mm and their coloration was a dark, dull red. The wasps exhibited black markings on their vertex, extending to the occiput, often reaching the apex of the antennae. Additionally, black markings were present on the propleuron, mesopleuron (with the exception of two red spots), metapleuron (excluding a red spot on the upper metapleuron), mesoscutum, base of petiole, apical half of the second tergite, and all subsequent tergites. The clypeus, which is the area between the eyes and the mandibles, was smooth, oval, and convex with a transverse anterior margin. The wings were on average 24 mm long and ferruginous in color, being three times longer than their width. The metasoma, or the part of the body behind the waist, was smooth and brightly coloured (Fig. 2).

Fig. 2: Emerged individuals of *Delta dimidiatipenne* (de Saussure, 1852). Scale bar = 1 cm. (Photo: A. Kheloufi)

Based on Fig. 3, it is evident that the primary building materials for the nest are a mixture of mud and sand grains. This was further verified through laboratory analysis of the nest's constituents. The nest itself was approximately 10 cm in length and 3 cm in width. It comprised five cells, and each cell had dimensions of 3 cm in length, 2 cm in width, and 1.5 cm in thickness. The species uses a mixture of sand grains and a durable soil mastic made from dry soil material mixed with regurgitated liquid to construct their nest cells. The nest cells have

a dome shape (Fig. 3 A). However, it is important to note that in all *Delta* species, a single cell is typically filled with the same species of prey, including the presence of a fifth cell in this particular nest. Caterpillars belonging to the families Noctuidae, Tortricidae, Hesperiidae, Geometridae, Lycaenidae, Pieridae, and Pterophoridae (Lepidoptera) are included in the prey spectrum of species within the family Eumeninae. These caterpillars are introduced into the nest cell through the narrow neck of the nest, as described by Matthews and Matthews (2018). According to Bodlah et al. (2012), all *Delta* species examined construct clay nests on the surfaces of rocks and buildings in arid and semi-arid regions.

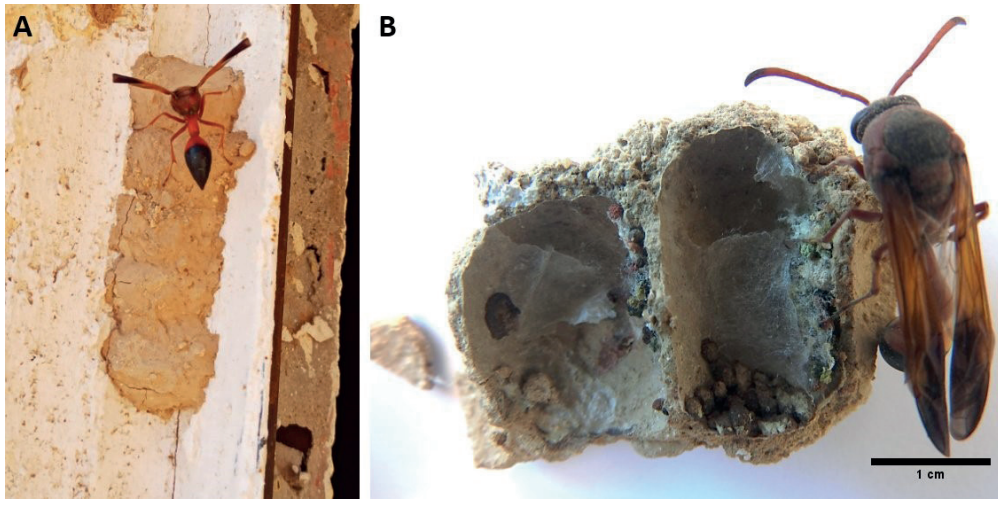

Fig. 3: Nesting of *Delta dimidiatipenne* (de Saussure, 1852): A - Adult female sealing the nest. B - Details of a fraction of the nest. Scale bar = 1 cm. (Photo: A. Kheloufi).

Overall, this study serves as baseline ecological data of *Delta dimidiatipenne* in northwestern Algeria, a species within the *Delta* genus with a wide geographical distribution. By documenting its first sighting in Algeria, this research contributes some insights into the nesting behaviour. As a result of these findings, we are better informed about the distribution and ecology of this species, which will lead to further research and conservation efforts by scientists in this region in the future.

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Author's address: Abdenour Kheloufi, University of Batna 2, Address: 53, Route de Constantine, Fesdis. Batna 05078. Algeria; Department of ecology and Environment, Faculty of Natural and Life Sciences, University of Batna 2, Batna, Algeria; Laboratory of Biotechnology for Food and Energy Security, University of Oran 1, Oran, Algeria,
email: a.kheloufi@univ-batna2.dz