

NOTES ON SPECIES OF VESPID WASPS (VESPIDAE: HYMENOPTERA) IN THE CENTRAL HIGHLAND, VIETNAM

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ARTICLE INFO	ABSTRACT
Received: 18/3/2022	To have more knowledge for understanding the diversity of the family Vespidae in the Gia Lai and Dak Lak provinces, we conducted this study to clarify the species composition and distribution of wasps in the Vespidae at different altitudinal zones. The specimen were collected by sweep net. The species composition and distribution of wasps in the family Vespidae from two altitudinal zones (in Gia Lai and Dak Lak provinces) are provided. The result shows that 74 species of 32 genera of four subfamilies (Sternogastrinae, Polistinae, Vespinae and Eumeninae) were recorded. Of those, 31 species of 18 genera were recorded in both altitudinal zones; 55 species of 30 genera were only recorded at an altitude around 800 m (in Gia Lai); 50 species of 22 genera were only recorded at an altitude lower (300-500 m) (in Dak Lak). In addition, <i>Eustenogaster fraterna</i> is newly recorded for Vietnamese fauna, and its nest description is also provided. The results of this study will serve as a basis for further studies on the biodiversity and conservation of this group.
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NHỮNG GHI CHÉP VỀ CÁC LOÀI ONG BẮT MỖI THUỘC HỌ ONG VÀNG (VESPIDAE: HYMENOPTERA) TẠI CÁC TỈNH THUỘC KHU VỰC TÂY NGUYÊN

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THÔNG TIN BÀI BÁO	TÓM TẮT
Ngày nhận bài: 18/3/2022	Để có thêm kiến thức về đa dạng các loài ong bắt mồi họ Vespidae ở Gia Lai và Đắk Lắk, chúng tôi đã tiến hành nghiên cứu làm rõ thành phần và phân bố của họ Vespidae ở các đai độ cao khác nhau. Mẫu vật được thu bắt bằng phương pháp vợt tay. Thành phần loài và sự phân bố của các loài ong bắt mồi thuộc họ Ong vàng ở hai đai độ cao ở tỉnh Gia Lai và Đắk Lắk thuộc khu vực Tây Nguyên được cung cấp. Kết quả cho thấy 74 loài thuộc 32 giống của 4 phân họ (Sternogastrinae, Polistinae, Vespinae và Eumeninae), họ Ong vàng Vespidae đã được ghi nhận. Trong số đó, 32 loài thuộc 18 giống được ghi nhận ở cả hai đai độ cao; 55 loài thuộc 30 giống chỉ được ghi nhận ở độ cao 800 m (tỉnh Gia Lai); 50 loài thuộc 22 giống chỉ được ghi nhận ở độ cao thấp hơn (300-500 m) (tỉnh Đắk Lắk). Loài Ong vàng <i>Eustenogaster fraterna</i> là loài ghi nhận mới cho khu hệ côn trùng Việt Nam và tổ của loài này cũng đã được mô tả. Kết quả của nghiên cứu này sẽ là cơ sở cho các nghiên cứu sâu hơn về đa dạng sinh học và bảo tồn của nhóm này.
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1. Introduction

Vespidae is a diverse family which has about 5400 species distributed worldwide [1], including 4 subfamilies in Southeast Asia, in which three subfamilies are social wasps (Stenogastrinae, Polistinae and Vespinae) and one subfamily is solitary wasps (Eumeninae) [2]. In Vietnam, 92 species of social wasps [3] and 45 species of solitary wasps have been recorded [4]. Up to date, eight genera and 22 species have been added to this list, including 15 species that were described as new to science [5]-[24]. Research on social wasps species has been carried out in four provinces in the Central Highlands (Kon Tum, Gia Lai, Dak Lak, Dak Nong), 30 species of social wasps belonging to 9 genera have been recorded [25]. Most species of Vespidae are predators, their food is pests and small insects. Therefore, they can be used as natural enemies to inhibit the number of pests and can be used in the prevention of pests in agriculture. Additionally, they are also capable of pollinating plants.

Gia Lai is a mountainous province located in the north of the Central Highlands at an average altitude of 800 meters above sea level [26]. Gia Lai belongs to the tropical monsoon highland climate. The climate is divided into two distinct seasons: the rainy season and the dry season. Meanwhile, Dak Lak province is located in the center of the Central Highlands. The topography of the province is very diverse, located in the West and end of the Truong Son range. Dak Lak is a large plateau, and the terrain is gently sloping, interspersed with low plains along the main rivers. The province's climate is divided into two sub-regions: the northwest region has a hot and dry climate in the dry season, and the eastern and southern regions have a cool and temperate climate. In general, the average altitude of the Dak Lak province is from 100-770 m [26], with a hot and humid climate.

To have more knowledge for understanding the diversity of the family Vespidae in the Gia Lai and Dak Lak provinces, we conducted this study to clarify the species composition and distribution of wasps in the Vespidae at different altitudinal zones. We chose an altitude of around 800 m in Gia Lai and an altitude of 300-500 m in Dak Lak to reflect the specificity of species composition in these two provinces. The results of this study will serve as a basis for further studies on the biodiversity and conservation of this group.

2. Material and methods

Sampling locations:

Gia Lai: Kon Chu Rang NR (K Bang) in 2016 (April), 2017 (June) and 2018 (November), Kon Ka Kinh NP (Mang Yang) in 2020 (September) (areas for collecting around 800 m).

Dak Lak: Chu Yang Sin NP (Krong Bong) in 2017 (June) and 2019 (August), Dray Sap (Krong Ana), Eaphe (Krong Pak), Tan An, Tan Hoa, Eakao (Buon Me Thuot city) in 2020 (June and July) (areas for collecting ranging from 300 m to 500 m).

Sampling method:

The survey was conducted at two different altitudinal zones in Gia Lai and Dak Lak provinces as mentioned above. The specimens were collected with a sweep net. The samples were collected following Ta et al., 2004 [27]. The survey method has been modified to suit family Vespidae. The total length of the survey is 10 km with 3 surveyors collecting samples. Insects are collected with a sweep net, the objects are insects that are perched on trees, on the ground or in flight. Sampling space from the ground to a height of 5 m. The collection take place when an insect is seen and every 100 m racquets are randomly 10 times on the grass. The total investigation time at a site usually lasts within about 5 days.

Preservation method: Most of the specimens collected will be pinned and dried, the rest will be preserved in absolute alcohol for later DNA research.

Identification methods: The identification of the wasps was based on some references such as Giordani Soika, 1941 [28]; van der Vecht, 1963 [29]; Yamane, 1990 [30]; Nguyen 2015a, d;

2016b, c; 2017; 2020; Nguyen & Carpenter, 2017; Nguyen et al., 2018a, 2019 [7], [10], [12]-[14], [3], [17], [18], [21].

Image processing method:

Photographic images were made with a Nikon SMZ 800N digital stereo microscope, and with ILCE-5000L/WAP2 digital camera attached to that. Photographs were combined using Helicon Focus 7 software. The plates were finished with Photoshop CS6.

3. Results and discussion

The species composition of vespid wasps in Gia Lai and Dak Lak provinces collected over five years, from 2016 to 2020, is presented in Table 1.

Table 1. Species composition of vespid wasps (Vespidae) in Gia Lai and Dak Lak

No	Taxon	Altitude around 800 m (Gia Lai)	Altitude 300- 500 m (Dak Lak)	Nest recorded
Subfamily Stenogastrinae				
1.	<i>Cochlischnogaster spatulata</i> (Carpenter and Starr, 2000)	+	+	+
2.	<i>Eustenogaster fraterna</i> (Bingham, 1897) (*)	+		+
3.	<i>Eustenogaster nigra</i> Saito and Nguyen, 2006	+		+
4.	<i>Eustenogaster vietnamensis</i> Saito, 2009		+	+
5.	<i>Liostenogaster filicis</i> Turillazzi, 1999	+		+
6.	<i>Liostenogaster nitidipennis</i> (de Saussure, 1853)		+	+
7.	<i>Parischnogaster mellyi</i> (de Saussure, 1852)	+	+	+
Subfamily Polistinae				
8.	<i>Polistes brunus</i> Nguyen & Carpenter, 2017		+	
9.	<i>Polistes chuyangsin</i> Nguyen & Nguyen, 2018		+	+
10.	<i>Polistes communalis</i> Nguyen, Vu & Carpenter, 2017		+	+
11.	<i>Polistes delhiensis</i> Das and Gupta, 1984	+	+	+
12.	<i>Polistes japonicus</i> de Saussure, 1858	+	+	
13.	<i>Polistes longus</i> Nguyen & Carpenter, 2019	+	+	+
14.	<i>Polistes meadeanus</i> (von Schulthess, 1913)		+	
15.	<i>Polistes nigratarsis</i> Cameron, 1900		+	
16.	<i>Polistes olivaceus</i> (DeGeer, 1773)	+	+	
17.	<i>Polistes rothneyi</i> Cameron, 1900	+		+
18.	<i>Polistes sagittarius</i> de Saussure, 1853	+	+	+
19.	<i>Polistes stigma</i> (Fabricius, 1793)		+	
20.	<i>Polistes tenebriosus</i> Lepeletier, 1836	+		
21.	<i>Ropalidia artifex</i> (de Saussure, 1853)	+		
22.	<i>Ropalidia bicolorata</i> van der Vecht, 1962	+	+	
23.	<i>Ropalidia binghami</i> van der Vecht, 1941		+	
24.	<i>Ropalidia flavopicta</i> (Smith, 1857)	+		
25.	<i>Ropalidia marginata</i> (Lepeletier, 1836)		+	
26.	<i>Ropalidia ornaticeps</i> (Cameron, 1900)	+	+	+
27.	<i>Ropalidia rufocollaris</i> (Cameron, 1900)	+	+	+
28.	<i>Ropalidia</i> sp1		+	
29.	<i>Ropalidia stigma</i> (Smith, 1858)	+	+	
30.	<i>Ropalidia sumatrae</i> (Weber, 1801)	+		
31.	<i>Ropalidia vietnama</i> Gusenleitner, 1996	+	+	
32.	<i>Parapolybia indica</i> (de Saussure, 1854)	+	+	+
33.	<i>Parapolybia varia</i> (Fabricius, 1787)	+	+	+
34.	<i>Polybioides gracilis</i> van der Vecht, 1966	+		
Subfamily Vespinae				
35.	<i>Provespa barthelemyi</i> (du Buysson, 1905)	+	+	

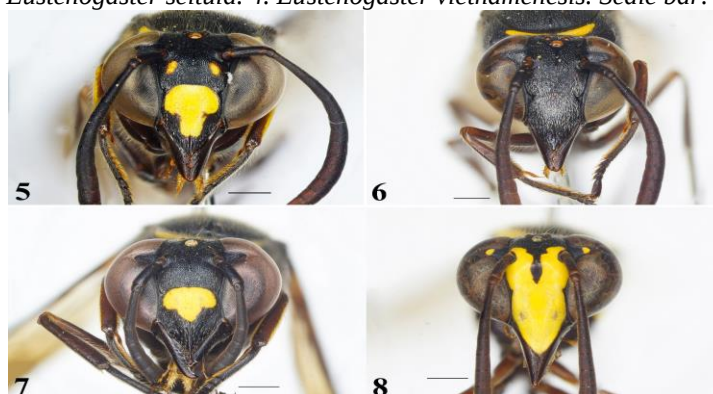
No	Taxon	Altitude around 800 m (Gia Lai)	Altitude 300- 500 m (Dak Lak)	Nest recorded
36.	<i>Vespa affinis</i> (Linnaeus, 1763)	+	+	
37.	<i>Vespa analis</i> Fabricius, 1775	+		
38.	<i>Vespa bicolor</i> Fabricius, 1787	+	+	
39.	<i>Vespa ducalis</i> Smith, 1852	+		
40.	<i>Vespa mocsaryana</i> du Buysson, 1905	+		+
41.	<i>Vespa soror</i> du Buysson, 1905	+		
42.	<i>Vespa velutina</i> Lepeletier, 1836	+	+	
Subfamily Eumeninae				
43.	<i>Allorhynchium argentatum</i> (Fabricius, 1804)	+	+	
44.	<i>Antepipona biguttata</i> (Fabricius, 1787)	+	+	
45.	<i>Anterhynchium flavomarginatum</i> <i>flavomarginatum</i> (Smith, 1852)	+	+	
46.	<i>Anterhynchium punctatum</i> Nguyen, 2015		+	
47.	<i>Apodynerus troglodytes troglodytes</i> (de Saussure, 1855)	+	+	
48.	<i>Calligaster himalayensis</i> (Cameron, 1904)		+	
49.	<i>Calligaster himalayensis</i> (Cameron, 1904)	+	+	
50.	<i>Coeleumenes burmanicus</i> (Bingham, 1897)	+		
51.	<i>Delta campaniforme campaniforme</i> (Fabricius, 1775)		+	
52.	<i>Delta conoideum</i> (Gmelin, 1790)		+	
53.	<i>Delta esuriense esuriense</i> (Fabricius, 1787)	+	+	
54.	<i>Delta pyriforme pyriforme</i> (Fabricius, 1775)	+	+	+
55.	<i>Ectopioglossa sublaevis</i> (Smith, 1857)	+		
56.	<i>Eumenes inconspicuus</i> Smith, 1858	+	+	
57.	<i>Eumenes labiatus sinicus</i> Giordani Soika, 1941	+	+	
58.	<i>Eumenes multipictus</i> de Saussure, 1855	+		
59.	<i>Labus clypeatus</i> van der Vecht, 1935		+	
60.	<i>Malayepipona clypeata</i> Nguyen & Carpenter 2013	+		
61.	<i>Maylayepipona fincta</i> Nguyen, 2020		+	
62.	<i>Omicroides singularis</i> (Smith, 1858)	+		
63.	<i>Orancistrocerus aterrimus erythropus</i> (Bingham, 1897)	+	+	
64.	<i>Paraleptomenes communis</i> Giordani Soika, 1994	+		
65.	<i>Phimenes flavopictus continentalis</i> (Zimmermann, 1931)	+	+	
66.	<i>Phimenes indosinensis</i> (van der Vecht, 1959)		+	
67.	<i>Pseudozumia indica borneana</i> Giordani Soika, 1960	+		
68.	<i>Pseumenes depressus depressus</i> (de Saussure, 1855)	+		
69.	<i>Rhynchium brunneum brunneum</i> (Fabricius, 1793)	+	+	
70.	<i>Stenodyneriellus guttulatus</i> (de Saussure, 1862)	+		
71.	<i>Stenodyneriellus heterospilus</i> (Cameron, 1907)	+		
72.	<i>Subancistrocerus sichelli</i> Saussure, 1856	+	+	
73.	<i>Subancistrocerus</i> sp1		+	
74.	<i>Zethus dolosus</i> Bingham, 1897	+		

Notes: (*): New record for Vietnam

The result of this study showed that 74 species of 32 genera belonging to four subfamilies (Stenogastrinae, Polistinae, Vespinae and Eumeninae) were recorded. Of those, 31 species of 18 genera were recorded at both altitudes. At the altitude of around 800 m (Gia Lai province), 55 species of 30 genera were recorded. Otherwise, 50 species of 22 genera appeared at a lower altitude of 300-500 m (Dak Lak province).



Figures 1-4. Habitus of *Eustenogaster* species, males. 1. *Eustenogaster fraterna*. 2. *Eustenogaster nigra*. 3. *Eustenogaster scitula*. 4. *Eustenogaster vietnamensis*. Scale bar: 1 mm



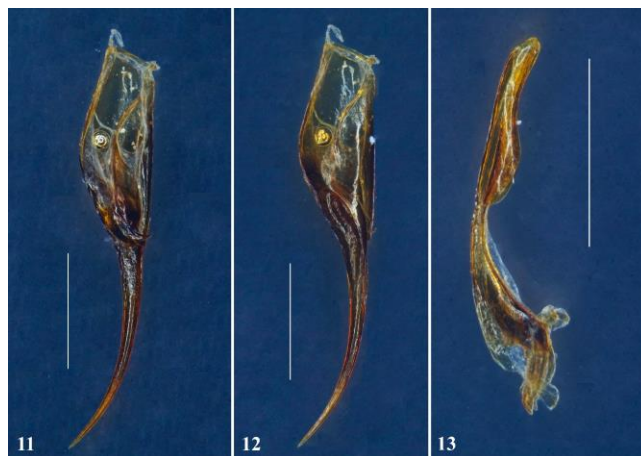
Figures 5-8. Head of *Eustenogaster* species, males. 5. *Eustenogaster fraterna*. 6. *Eustenogaster nigra*. 7. *Eustenogaster scitula*. 8. *Eustenogaster vietnamensis*. Scale bar: 1 mm



Figures 9-10. Propodeum of *Eustenogaster* species, males. 9. *Eustenogaster nigra*. 10. *Eustenogaster scitula*.

In Vietnam, nine species of four genera belonging to the subfamily Stenogastrinae were recognized [3]. At these two study sites, seven species in four genera have been recognized. Of those, two species occurred in both study sites (*Cochlischnogaster spatulata* and *Parischnogaster mellyi*), three species only occurred at an altitude of around 800 m (*Eustenogaster fraterna*, *E. nigra* and *Liostenogaster filicis*) and an altitude of 300-500 m, there were two species

(*Eustenogaster vietnamensis* and *Liostenogaster nitidipennis*). Two species *Cochlischnogaster spatulata* and *Liostenogaster nitidipennis* were only occurred from mid-central to the central highland, and *Eustenogaster vietnamensis* is distributed from mid-central to the southern part of Vietnam [3]. Especially, *Eustenogaster fraterna* is newly recorded for the fauna of Vietnam.



Figures 11-13. Genitalia of *Eustenogaster fraterna*. 11, 12. Aspect of paramere with digitus and volsella. 13. Aedeagus, lateral view. Scale bar: 1 mm



Figures 14-15. Nest of *Eustenogaster fraterna*

Subfamily Polistinae has 1024 extant species in 25 genera worldwide [1]. They are grouped into four tribes: Polistini, Mischocyttarini, Epiponini, and Ropalidiini. In Vietnam, 51 species belonging to four genera in two tribes, Polisini and Ropalidiini have been recorded [3], and 27 species and three genera have been recorded in this study. Six species that were recorded only at an altitude of around 800 m but not at an altitude of 300-500 m: *Polistes rothneyi*, *P. tenebricosus*, *Ropalidia artifex*, *R. flavopicta*, *R. sumatrae* and *Polybioides gracilis*. Of these, *Ropalidia sumatrae* and *Polybioides gracilis* have been recorded only in Gia Lai province. Out of a total of nine species were only recorded at altitude of 300-500 m in this study: *Polistes brunus*, *P. Chuyangsin*, *P. communalis*, *P. Meadeanus*, *P. nigratarsis*, *P. stigma*, *Ropalidia binghami*, *R. sp1.* and *R. marginat*. *Polistes chuyangsin* is only distributed in Dak Lak, *Polistes meadeanus* and *Ropalidia binghami* are only distributed in Central Highland. *Ropalidia vietnama* is only distributed in the southern part of Vietnam [3]. *Ropalidia sp1* has only been identified to the genus name and is possibly a new species for science.

At two altitudes, eight species in two genera belonging to the subfamily Vespinae have been recorded. All of them occurred at an altitude of around 800 m. Four species occurred at an altitude of 300-500 m (*Provespa barthelemyi*, *Vespa affinis*, *V. bicolor*, and *V. velutina*). In particular, *Vespa ducalis* was recorded in the southern part of Vietnam for the first time, it has only been recorded in the northern part before (Ha Giang, Bac Kan, Yen Bai, Son La, Phu Tho, Bac Ninh, Bac Giang) [3].

In the study, 32 species of 21 genera belonging to the subfamily Eumeninae were recorded, of which 13 species were recorded at both study sites. Among them, 12 species in ten genera were common species: *Allorhynchium* (1 species), *Antepipona* (1 species), *Anterhynchium* (1 species), *Apodynerus* (1 species), *Calligaster* (1 species), *Delta* (2 species), *Eumenes* (2 species), *Orancistrocerus* (1 species), *Phimenes* (1 species) and *Rhynchium* (1 species). They are widely distributed in Vietnam. *Subancistrocerus sichelli* is narrowly distributed as it has been recorded only in Dak Lak and Gia Lai provinces [31].

There were 11 species only recorded at an altitude of around 800 m: *Coeleumenes burmanicus*, *Ectopioglossa sublaevis*, *Eumenes multipictus*, *Malayepipona clypeata*, *Omicroides singularis*, *Paraleptomenes communis*, *Pseudozumia indica borneana*, *Pseumenes depressus depressus*, *Stenodyneriellus guttulatus*, *Stenodyneriellus heterospilus*, and *Zethus dolosus*. Of them, *Stenodyneriellus guttulatus* was only recorded in Lang Son province before [19], and in this study, Gia Lai is a new distribution of this species.

There were eight species only recorded at an altitude of 300-500 m: *Anterhynchium punctatum*, *Calligaster himalayensis*, *Delta campaniforme campaniforme*, *Delta conoideum*, *Labus clypeatus*, *Maylayepipona fincta*, *Phimenes indosinensis*, and *Subancistrocerus* sp1. Genus *Delta* is widely distributed in South-east Asia, and there are four species in the world, all of them have been recorded in Vietnam. Two species that are common in Vietnam and two species, *Delta campaniforme campaniforme* and *Delta conoideum* are only recorded in the Central Highlands. *Maylayepipona fincta* was described as a new species based on a specimen collected in Dak Lak [22]. Currently, it has only been recorded in Dak Lak province. In the world, *Phimenes indosinensis* is distributed in India (Assam), Myanmar, and Laos. It is supposed to occur widely in Vietnam as it has been recorded in one province of North Vietnam (Son La province) and one province in the Centre Highlands (Dak Lak). *Subancistrocerus* sp1 has only been identified to the genus, and study of this species will be continued in the future.

There are 15 species in the genus *Eustenogaster* worldwide, three of which are found in Vietnam. Of them, *Eustenogaster fraterna* is newly recorded for Vietnam fauna. In the world, this species has been known in India, Myanmar, Thailand, and Malaysia [32]. Below, the diagnosis and nest description of this species is provided.

***Eustenogaster fraterna* (Bingham, 1897)**

Diagnosis: In male: antenna with 11 flagellomeres; metasoma seven-segmented; mandible with three blunt teeth; clypeus (Fig. 5) yellow except for black apex and lateral margin, weakly convex, with extreme apex sharply pointed; supraclypeal area with paired yellow spots; metasoma petiolate, second tergum in profile weakly convex dorsally. Penis valves about 0.8 times as long as basal apodeme (Fig. 13); parameral with few hairs (Fig. 11, 12).

Nest description: The nest (Fig. 14) was attached with a thin branch. The branch penetrates the basal part of the nest, with a free end hanging beyond the nest. As in all known *Eustenogaster* species, the nest has an inverted-flask-shaped envelope. The envelope is made by extending the outer wall of peripheral cells, and thus its basal portion is comprised of the outer walls of peripheral cells. The apical, tubular part of the envelope is about 46 mm long and about 10 mm in diameter, with a broad horizontal flange near the apex. The outer surface of the envelope is furnished with several keels, which run down continuously, slightly spirally, to the apical flange. The colour of the nest is basically brown, with transverse thin stripes light and dark interleaved, it reveals that the nest is made by different source of the material. The comb (Fig. 15) consists of 18 cells, which are hexagonal in cross section. The cells in the central part of the comb are 7-8 mm in diameter (5 side-to-side distance) at the opening and 11-13 mm long; peripheral cells are somewhat larger (8-9 mm in diameter) and shorter (8-10 mm in length). The nest carton is brittle, made from small chips mixed with a small amount of (possibly salivary) secretion.

Material examined: Vietnam: 1 male, **Gia Lai**, Kbang, Son Lang, Kon Chu Rang NR, 14°28'27" N, 108°32'23.9" E, 883m, 20.iv.2015, Nest-VN-TN-2015-E-01, Nguyen Thi Phuong

Lien, Nguyen Dac Dai, Nguyen Phuong Minh; 8 males, **Kon Tum**, Dak Ha, Dak Mar, Dak Uy, 14°33'04.6" N, 107°55'08" E, 630m, 19.vii.2012, Nguyen Thi Phuong Lien.

Distribution: India: Assam, Sikkim; Myanmar; Thailand; Malaysia: Peninsular Malaysia; Vietnam (new record).

Here we give a key to all species of the genus *Eustenogaster* occurring in Vietnam, including a newly recorded species.

Key to species of genus *Eustenogaster* in Vietnam

1. Mandible with three teeth (Figs. 5, 6, 7).....2
 - Mandible with single-tooth (Fig. 8).....*vietnamensis*
2. Second tergum in profile weakly convex dorsally (Fig. 1).....*fraterna*
 - Second tergum in profile strongly convex dorsally (Figs. 2, 3).....3
3. Second tergum in lateral view strongly swollen dorsally in anterior half. Clypeus and propodeum entirely black (Fig. 6).....*nigra*
 - Second tergum less strongly convex dorsally. Clypeus usually with a median yellow spot of variable size, rarely entirely black; propodeum with paired apical yellow spots (Fig. 7).....*sticula*

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