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Source: American Museum Novitates, 2011(3709) : 1-10

Published By: American Museum of Natural History

URL: <https://doi.org/10.1206/3709.2>

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Taxonomic Notes on the Vespinae of Yunnan (Hymenoptera: Vespidae)

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ABSTRACT

In recent years, five new species of Vespinae have been described from Yunnan Province, China. A thorough assessment of these taxa, including study of color differences and compilation of measurements of specimens from six entomological collections, shows that the new taxa are merely variants of existing, nominal species. Thus, all five are synonymized here, as follows: *Vespa hekouensis* Dong and Wang, and *Vespa maguanensis* Dong = *Vespa analis* Fabricius; *Vespula yulongensis* Dong and Wang = *Vespula flaviceps* (Smith); *Vespula nujiangensis* Dong and Wang = *Vespula orbata* (du Buysson); and *Vespula gongshanensis* Dong = *Vespula rufa* (Linnaeus), all NEW SYNONYMY. The synonymies bring the current number of vespine species recognized worldwide to 67.

Key words: Vespidae, Vespinae, Yunnan.

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INTRODUCTION

During the past decade, Dong and coauthors (Dong, 2001; Dong et al., 2002, 2004, 2005; Dong and Wang, 2003) have described five endemic species of Vespinae from Yunnan Province in China. The descriptions were based on limited material (three of the species based on single specimens), with just a few characters—mostly the same ones used repeatedly—cited as distinguishing the new taxa from described species. A substantial part of these characters were measurements, but neither ranges nor values for compared forms were given. Most of the other characters were coloration.

As a result of these descriptions, 22 species of Vespinae are now recorded from Yunnan, five (23%) of them endemic. This compares with totals for neighboring countries of 14 species recorded from Vietnam, 12 from Laos, 20 from Myanmar, and 17 from Thailand—none of them endemic to the respective country (Carpenter and Kojima, 1997; Nguyen et al., 2006). There is nothing distinctive about the ecology of Yunnan relative to these neighboring countries to suggest that there should be a high level of endemism in the vespine fauna.

Most species of Vespinae have extensive distributions, and many show considerable color variation, so that historically many subspecies have been recognized (see Archer, 1989, and Carpenter and Kojima, 1997). In recent times these subspecies have come to be treated merely as synonyms of the nominate forms, at best informal local variants. Highly pertinent examples include *Vespa analis* Fabricius, known from India to Bali and through China to Siberia and into Korea and Japan; *Vespula rufa* (Linnaeus), transcontinental in Euro-Asia and in boreal North America; *Vespula orbata* (du Buysson), known from India and Southeast Asia; and *Vespula flaviceps* (Smith), known from India and Southeast Asia through China to Siberia and into Korea and Japan. As shall be shown, the color features by which the new species from Yunnan were distinguished are largely matched by known variation in these previously described forms. The other diagnostic characters of these new species are either the same in previously described taxa (in the case of all the morphological characters), or nearly entirely overlap with described taxa (in the case of measurements).

MATERIALS AND METHODS

All the distinguishing characteristics mentioned by Dong and colleagues were extracted from the original publications, using the English abstracts in addition to translation notes. Each paper mentioned a previously described species that was compared to the newly described one, and cited characters that were supposed to separate the two.

The resulting list of diagnostic characters was examined on specimens of each previously described species. We also decided not to limit the comparisons to just the species cited, but to expand them to other species and subspecies as well, as detailed below. All measurements were taken using ocular micrometers. Acronyms used for collections housing the specimens examined are as follows:

AMNH	American Museum of Natural History, New York, New York
IEBR	Institute of Ecology and Biological Resources, Vietnamese Academy of Science and Technology, Hanoi, Vietnam
IUNH	Natural History Collection at Ibaraki University, Mito, Japan
LDC	L. Dvořák, private collection, Tři Sekery, Czech Republic
MNHN	Muséum National d'Histoire Naturelle, Paris, France
TARI	Taiwan Agricultural Research Institute, Wufeng, Taichung, Taiwan

COMPARATIVE REVIEW

GENUS *VESPA*

Vespa hekouensis Dong and Wang, 2003: 407, fig. 2, female (Kunming [= Kunming Institute of Zoology, Academia Sinica]).

Described from a single female, collected in 1998.XI.11, and compared to *Vespa parallela* André and *V. maguanensis* Dong. *Vespa parallela* was universally treated as a subspecies of *V. analis* Fabricius since Bequaert (1939), until more recently sunk as a synonym of *V. analis* (Carpenter and Kojima, 1997; Archer, 1998a). Dong (2001) had earlier recognized *V. parallela* as a subspecies of *V. analis* when describing *V. maguanensis*, and the later change in status was not explained.

Diagnostic characters

Body length 32 mm; short and robust. A sample of specimens of *V. analis* in the AMNH ($n = 10$), IEBR ($n = 10$), IUNH ($n = 22$), LDC ($n = 6$), MNHN ($n = 9$) and TARI ($n = 8$) had a range in length of 18.6–37.1 mm, where length is taken from the head to the tip of the metasoma (see discussion under *Vespula gongshanensis*). The MNHN sample included four specimens of the series from Yunnan described by du Buysson (1903, 1905) as *Vespa nigrans*, which was treated as a subspecies of *V. analis* by Bequaert (1939).

Clypeus with narrow emargination; median process short. The size of the median process is known to be variable within *V. analis* (Bequaert, 1939: 37; van der Vecht 1957: 4), even occasionally being “small or rudimentary.” The relative size of the process therefore cannot be used as a diagnostic feature. The perceived width of the clypeal emargination is affected by the size of the process, and Dong and Wang’s (2003) figure 2c shows little difference from *V. maguanensis* (Dong, 2001: fig. 1) in this regard.

OOD/IOD = 0.4 [OOD = ocellar-ocellar distance; IOD = eye-ocellar distance.]; OCD/OOD = 6 [OCD = ocellar-occipital distance.]. A sample of specimens of *V. analis* in the AMNH ($n = 10$), IEBR ($n = 10$), IUNH ($n = 22$), MNHN ($n = 9$) and TARI ($n = 8$) had a range in these ratios of 0.29–0.44 and 3.4–8, respectively.

Flagellomere I 2.1× length of flagellomere II. A sample of *V. analis* in the AMNH ($n = 10$), IEBR ($n = 10$), IUNH ($n = 22$), MNHN ($n = 9$) and TARI ($n = 8$) had a range in this ratio of flagellomere I 1.8–2.4× length of flagellomere II.

Metabasitarsus $3.5\times$ length of metatarsus II. Specimens of *V. analis* in the AMNH ($n = 18$), IEBR ($n = 10$), IUNH ($n = 22$), MNHN ($n = 9$) and TARI ($n = 8$) had a range in this ratio of metabasitarsus $2.4\text{--}3.4\times$ length of metatarsus II.

Metasomal terga I–II yellow with narrow brown band on posterior margin. This matches similar marks in *V. analis kuangsiensis* Bequaert (Bequaert, 1939: 38), described from “Kwangsi” [Guangxi], close to Yunnan. *Vespa analis* can produce several color variants within the same nest, which has previously led to confusion (Bequaert, 1939: 40).

Vespa maguanensis Dong, 2001: 82, figs. 1–5, female, male – “Yunnan China” (Kunming).

Described from the female and one male, collected 1998.XI.8, and compared to *Vespa analis* and *V. analis parallela*.

Diagnostic characters

Larger body, 36 mm in length. As mentioned above, a sample of *V. analis* in our collections had a range in (total) length of 18.6–37.1 mm. In the MNHN, workers of *V. analis* ranged between 28.9–32 mm ($n = 6$) and queens 33.7–36.7 mm ($n = 3$). It is therefore possible that the *Vespa maguanensis* measured was a queen while *V. hekouensis* was described from a worker. However, in the IUNH, workers from the same nest (collected in central Japan) ranged between 21.3–30.7 mm ($n = 10$) and queens of different nests (in Japan) 31.5–32 mm ($n = 2$) and queens in hibernation (in Laos) 25.7–30.1 mm ($n = 3$) in total length.

Clypeus broadly emarginate; median process thick and blunt. The variation in this feature has been discussed under *V. hekouensis*: the relative size of the process and emargination has long been known to vary in *V. analis*.

Distance between posterior ocelli [OOD] $0.5\times$ the distance between ocellus and eye [IOD]; distance between posterior ocellus and occiput [OCD] $4\times$ the distance between the posterior ocelli [OOD]. As mentioned above, a sample of 52 specimens of *V. analis* from the AMNH, IEBR, IUNH, MNHN and TARI had a range in these ratios of 0.29–0.44 and 3.4–3.8.

Metabasitarsus $2.5\times$ length of metatarsus II. As noted above, 59 specimens of *V. analis* in the AMNH, IEBR, IUNH, MNHN, and TARI had a range in this ratio of metabasitarsus $2.4\text{--}3.36\times$ length of metatarsus II.

Penis valve strongly projecting laterad toward end, and paramere with fingerlike process at middle (digitus?). The aedeagus projecting strongly laterad apically is a standard feature in *Vespa* species (Archer, 1989: figs. 34–38, 41–42; 1994a: fig. 4), and a fingerlike expansion of the digitus is common, including in *V. analis* (Archer, 1994a: figs. 5.3–5.6).

The color and markings were not cited as distinguishing this species, and are indeed similar to *V. analis nigrans* du Buysson, which was described from Yunnan (du Buysson, 1903). *Vespa analis parallela* and *V. a. nigrans* are known to intergrade (Bequaert, 1939: 41).

GENUS *VESPULA*

Vespula gongshanensis Dong, in Dong et al.: 65, female, male – “China ... Gongshan (27°47'N, 98°30'E), Yunnan Province, alt. 2 950 m” (holotype female Kunming).

Described from 387 females and one male, collected 2002.X.01, and compared to *Vespula rufa rufa* (Linnaeus). The latter has not been reported from China; instead two other subspecies have been recorded from northeastern China (*V. rufa schrenckii* Radoszkowski) and Sichuan (*V. rufa grahami* Archer) (Archer, 1997: fig. 3). These taxa were not mentioned by Dong et al. (2005), nor were the other Palearctic species of the *rufa* species group, *V. kingdonwardi* Archer and *V. nursei* Archer, although both have been recorded from China (Tibet, and Fujian and Hebei, respectively; Archer, 1997: fig. 1).

Diagnostic characters

Body length about 22 mm. Guiglia (1972: 99) gave the variation in length in *V. rufa rufa* as 15–17 mm for queens and 10–13 mm for workers, and Archer (1981: 63) gave for *V. rufa grahami* 16.7 mm for the (single) queen and 11.8–13.7 mm for the workers. The discrepancy between these ranges and the length given by Dong et al. (2005) is at least partly due to the fact that Guiglia and Archer measured length from the head to the end of tergum II, whereas Dong et al.'s body length was measured from the head to the tip of the metasoma, as verified with specimens in the AMNH. The method used by Guiglia and Archer is standard in vespid classification because telescoping of the terminal segments of the metasoma makes comparable measurements including those segments problematic. Approximate measurements of total length of a sample of *V. rufa queens* in the AMNH ($n = 9$) and LDC ($n = 18$) gave a range of 17.5–24.1 mm. A queen of the Nearctic form *V. rufa intermedia* (du Buysson) in the AMNH had a length of 21.2 mm, a queen of the Chinese form *V. rufa grahami* Archer in the AMNH had a length of 22.9 mm, and five queens of the northern Asian form *V. rufa schrenckii* (1 AMNH, 4 MNHN, one of the latter *V. sibirica* André) had a range in length of 19.0–21.9 mm.

Archer (1981: 59–60) gave the length variation in *V. nursei* as 16.2–18.5 mm for queens and 12.4–15.0 mm for workers, and in *V. kingdonwardi* as 17.1 mm for the (single) queen and 12.1–13.2 mm for the workers. A worker of *V. nursei* in the AMNH had a (total) length of 16.3 mm.

Considering the consistent differences between queens and workers for other Palearctic species of the *rufa* species group, the measurement given by Dong et al. (2005) was thus evidently for queen specimens, although presumably workers were collected.

Scape brownish red. *Vespula nursei* has the scape brown in part (Archer, 1981: 57). The scape in *V. rufa rufa* in Europe is quite variable, ranging from black to yellow ventrally (Guiglia, 1972: 99, 101), and it is yellow in *V. rufa grahami* from China (Archer, 1981). Specimens of *V. rufa rufa* queens in LDC all have the scape black with a reddish-brown tip.

Clypeus wider than long. This is generally true of the Palearctic species in the *rufa* group, including all the subspecies of *V. rufa*, *V. nursei*, and the social parasite *V. austriaca* (Panzer).

Occiput strongly concave medially. This is also generally true in the *V. rufa* species group, although *V. rufa intermedia* has the concavity perhaps less pronounced.

OOD $2\times$ IOD; OCD $0.5\times$ OOD. The first of these values is an obvious error: Dong et al.'s (2005: fig. 1) own figure of the head of *V. gongshanensis* shows that the distance between the ocelli is much less than between the ocellus and eye. The ratios were probably mistakenly juxtaposed: a sample of queens of *V. rufa* in the AMNH ($n = 8$) had a range in these ratios of 0.3–0.4 and 1.0–2.5, respectively; one queen of *V. rufa intermedia* (AMNH) had these ratios 0.4 and 2.3, a queen of *V. rufa grahami* (AMNH) had the ratios 0.4 and 1.0, and five queens of *V. rufa schrenckii* (1 AMNH, 4 MNHN) had a range in the ratios 0.36–0.44 and 1.0–1.3, respectively.

Metabasitarsus $3.3\times$ length of metatarsus II. A sample of queens of *V. rufa* in the AMNH ($n = 8$) had a range in this ratio of metabasitarsus 2.4 – $3.3\times$ length of metatarsus II. One queen of *V. rufa intermedia* (AMNH) had this ratio metabasitarsus $3.4\times$ length of metatarsus II; a queen of *V. rufa grahami* (AMNH) had the ratio 2.2; and five queens of *V. rufa schrenckii* (1 AMNH, 4 MNHN) had a range in the ratio of 3.0–3.4. A worker of *V. nursei* in the AMNH had the ratio metabasitarsus $2.8\times$ length of metatarsus II.

Frons, vertex, gena entirely yellow. The frons and gena are variably yellow in other Palearctic species of the *rufa* group, i.e., *V. rufa*, *V. nursei*, and *V. kingdonwardi* (Archer, 1981).

Scutum with U-shaped and curved brown marks. *V. rufa grahami* has yellow marks that tend to be tinged with brown (Archer, 1981: 63).

Scutellum, metanotum, propodeum black. The propodeum is generally black in other species of the *rufa* group, the scutellum marked with yellow, and the metanotum variable, either with spots or black (Guiglia, 1972: 101; Archer, 1981). The specimens in the AMNH and MNHN all have the scutellum marked with yellow, but the size of the spots is quite variable, with some specimens having these scarcely noticeable. A single queen of *V. rufa schrenckii* in LDC has the scutellum completely black.

Markings of metasoma. Dong et al.'s (2005) figure 4 shows semiattached black spots in pale apical bands on the third and fourth metasomal terga. This is common in the highly variable *V. rufa rufa* in Europe, as observed on the specimens in the AMNH.

Vesputa nujiangensis Dong and Wang, in Dong et al., 2004: 146, female, figs. 1–5 – [China] “Nujiang Liuku, Yunnan, Alt. 1 100 m. $25^{\circ}58'N$. $98^{\circ}65'E$.” (Kunming).

Described from a single female, collected 1996.IV.5 [given as September in abstract], and compared to *Vesputa minuta arisana* (Sonan). This subspecies was raised to species rank by Yamane and Tano (1985), and confirmed by Archer (2000) after studying the second known male. It is known only from Taiwan. On the other hand, *V. orbata* (du Buysson), senior synonym of *V. minuta* (Dover) *vide* Archer (1982), is distributed from northern India and Nepal to Myanmar, and has been recorded from northern Vietnam (Nguyen and Carpenter, 2002;

Nguyen et al., 2006), close to Yunnan. This species was not mentioned by Dong and Wang (2004).

Diagnostic characters

Body length 15 mm. Yamane et al. (1980: 31) gave the length in *V. minuta* as about 10 mm to the end of metasomal tergum II. A worker of *V. arisana* in the AMNH and three worker types of *V. arisana* in the TARI had a length of 14.9 mm (11.4 mm to the end of metasomal tergum II) and 11.2–12.9 mm (8.4–9.8 mm), respectively. A sample of workers of *V. orbata* in the AMNH ($n = 1$), IEBR/IUNH ($n = 10$), LDC ($n = 3$) and MNHN ($n = 1$) had a range in length of 12–19.7 mm.

Clypeus with a median longitudinal brownish mark. Similar coloration is found in many forms in the *vulgaris* species group (Yamane et al., 1980: figs. 47–53, 56–59, 67–72), including *V. orbata* (Yamane et al., 1980: 30).

The head is wider than the mesosoma. This is also true of both *V. arisana* and *V. orbata*.

ODD $0.3 \times$ IOD; OCD $1.2 \times$ OOD. A worker of *V. arisana* and one of *V. orbata* in the AMNH both had these ratios 0.25 and 1.0, respectively, while a worker of *V. orbata* in the MNHN had the ratios 0.25 and 1.33 and those in the IEBR/IUNH ($n = 10$) had the ratios 0.2–0.25 and 0.88–1.13.

Scutum entirely black. *Vespula orbata* usually has a brown and black scutum, but the brown is sometimes reduced (Archer, 1982: 265), as seen in a worker in LDC, which has the scutum completely black. The lectotype of *V. orbata* (MNHN) also has the scutum entirely black.

Metabasitarsus $5.8 \times$ length of metatarsus II. A worker of *V. arisana* in the AMNH had the ratio metabasitarsus $3.4 \times$ length of metatarsus II. A worker of *V. orbata* in the AMNH had the ratio metabasitarsus $5.0 \times$ length of metatarsus II on one leg—but 3.6 on the other. A worker of *V. orbata* in the MNHN had the ratio 3.1, and 10 workers of *V. orbata* in the IEBR/IUNH had the ratio between 3.25–3.55.

Metasomal terga II–VI brown with blackish transverse bands basally. This color pattern is similar to that found in variants of *V. orbata* (Archer, 1982: 265, 266); the workers of *V. orbata* in the IEBR/IUNH have the metasomal terga I and II (sometimes also tergum III) black with a narrow yellow transverse apical band and terga III–VI brown with wide blackish-brown transverse bands basally. The lectotype and a worker in the MNHN have only a narrow yellow-brownish apical band on tergum II.

Vespula yulongensis Dong and Wang, in Dong et al., 2002: 396, female – “YUNNAN CHINA” (Kunming).

Described from a single female, collected 1992.V.25, and compared to *Vespula gracilia* Lee. Dong et al. (2002) evidently overlooked that *V. gracilia* was synonymized with *V. flaviceps* (Smith) by Archer (1990, 1993, 1994b), although this is now standard in checklists

(Carpenter and Kojima, 1997). While *V. gracilia* was described only from Zhejiang and Fujian in China, *V. flaviceps* is widely distributed in East Asia, and has been recorded from Yunnan (Archer, 1998b, as *flavipes* [!]).

Diagnostic characters

Body length 17 mm. Yamane et al. (1980: 8) gave the length in *V. flaviceps* as 11–14 mm to the end of metasomal tergum II in queens and 7.0–10.5 mm in workers. A sample of queens in the AMNH ($n = 7$) had a range in (total) length of 18.5–21.2 mm (12.6–14.1 mm to the end of metasomal tergum II), while samples of queens in LDC ($n = 5$), IUNH ($n = 10$ from the same nest), MNHN ($n = 4$; one from China: Zhejiang), and TARI ($n = 3$; including the holotype of *Vespa quadrimaculata* Sonan) had ranges of 16–17 mm, 14.0–16.5 (10.3–11.5 mm to the end of metasomal tergum II), 17.4–19.6 mm (12.8–13.6 mm to the end of metasomal tergum II), and 13.5–15.2 (10.7–11.2 mm to the end of metasomal tergum II), respectively. The measurement given by Dong and Wang (2002) was thus evidently for a rather small queen specimen.

Clypeus broader than long, yellow with a narrow, vertically widening medial black band. This band is also present in most specimens of *V. flaviceps* (Yamane et al., 1980: 7), and the clypeus is broader than long.

Scutellum black with yellow laterally. This coloration is present in several members of the *vulgaris* species group, including *V. flaviceps* (Yamane et al., 1980).

OOD $0.3 \times$ IOD; OCD $1.8 \times$ OOD. A sample of queens of *V. flaviceps* in the AMNH ($n = 8$), IUNH ($n = 10$ from the same nest), MNHN ($n = 4$), and TARI ($n = 3$) had a range in these ratios of 0.3–0.4 and 1.0–1.5, respectively.

Metabasitarsus $3.4 \times$ length of metatarsus II. A sample of queens of *V. flaviceps* in the AMNH ($n = 8$), IUNH ($n = 10$ from the same nest), MNHN ($n = 4$), and TARI ($n = 3$) had a range in this ratio of metabasitarsus 2.8 – $3.6 \times$ length of metatarsus II.

Metasomal terga II–V yellow with a black spot on each side. This is similar to the markings of *V. flaviceps flaviceps* (Yamane et al., 1980: figs. 90–91), and one specimen in the MNHN from China: Zhejiang (“Chekiang, Hangtcheou, A. Pichon 1925”).

CONCLUSIONS

We have shown that most of the features cited by Dong and coauthors as diagnosing their new species are matched in previously described taxa. Some features, such as the supposedly unique aedeagus of *Vespa maguanensis*, are actually characteristic of the genus. Measurements generally overlap the observed ranges for known species—and those few that fall outside the ranges are not far enough out to be considered significant. Some measurements, such as total body length but also OCD and length of metatarsus II, are poorly defined. Coloration is generally similar as well. The diagnostic features are not in fact diagnostic, hence the conclusion must be that the five species are not actually new. Even before undertaking this review, there were significant doubts about the supposed new species. The descriptions were based on limited material,

diagnostic features cited and comparisons with relevant described taxa were limited, and the published figures were lacking in detail. We are therefore synonymizing them, as follows.

Vespa analis Fabricius, 1775

Vespa hekouensis Dong and Wang, 2003, NEW SYNONYMY.

Vespa maguanensis Dong, 2001, NEW SYNONYMY.

Vespula flaviceps (Smith, 1870)

Vespula yulongensis Dong and Wang, 2002, NEW SYNONYMY.

Vespula orbata (du Buysson, 1902)

Vespula nujiangensis Dong and Wang, 2004, NEW SYNONYMY.

Vespula rufa (Linnaeus, 1758)

Vespula gongshanensis Dong, 2005, NEW SYNONYMY.

ACKNOWLEDGMENTS

We thank Jeremy Frank for assistance with compiling measurements and data on variation, and Zhiwei Liu for some translation. Support for J.M.C. and K.M.P. was provided by National Science Foundation Grant DEB-0843505 and that for J.K. and L.T.P.N. by the Japan Society for the Promotion of Science Grant 20•08416.

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