

FIRST RECORD OF THE GENUS *LYCOGASTER* (HYMENOPTERA: TRIGONALIDAE) FROM VIETNAM, WITH NOTES ON THE VARIABILITY AND BIOLOGY OF *L. FLAVONIGRATA*

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Summary. The genus *Lycogaster* Shuckard, 1841 is recorded from Vietnam for the first time based on the specimens of *L. flavonigrata* Chen, Achterberg, He et Xu, 2014 collected from 2017 to 2025. Variation of external morphological characters is discussed and the notes on the biology of the species are presented.

Key words: parasitic wasp, fauna, *Lycogaster flavonigrata*, biology, morphological variation, South-East Asia.

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Резюме. Род *Lycogaster* Shuckard, 1841 впервые зарегистрирован во Вьетнаме на основании экземпляров *L. flavonigrata* Chen, Achterberg, He et Xu, 2014, собранных в период с 2017 по 2025 год. Обсуждается изменчивость внешних морфологических признаков и представлены сведения о биологии вида.

INTRODUCTION

Trigonalidae is a small family of parasitic wasps, with around 120 species in 16 genera worldwide (Lelej, 2019; Zhang *et al.*, 2022; Kumar & Hegde, 2023). Most Trigonalidae are relatively stocky, medium sized wasps, and black with yellow or white markings. Diagnostic morphological characters for the Trigonalidae include fore wings usually with 10 closed cells, mandibles with 3–5 large teeth, 2-segmented trochanters, hyaline plantar lobes on the tarsal segments, cleft tarsal claws, antennae usually with 16–27 segments, females with sparse white scales or specialized setae on the outside of the middle antennal segments (Carmean, 1991; Carmean & Kimsey, 1998).

Trigonalidae are parasitoids with a most distinctive life history, which usually involves two successive, obligate hosts, folivorous larvae as intermediate hosts and ichneumonid and

vespid wasps or tachinid flies as ultimate hosts. Trigonalysid females lay the thousands of eggs in or on foliage and these eggs are ingested by folivorous caterpillars or sawfly wasps. After ingestion, the eggs hatch inside the host gut, and the Trigonalysid larvae make their way into the haemocoel and wait to remove to the ultimate hosts. They use the latter to develop and complete their life cycle. Although a large number of eggs are laid and many larvae can reach the ultimate host, one Trigonalysid adult emerges (Carmean, 1991; Carmean & Kimsey, 1998).

Trygonalysids, as far as known, are univoltine, and the lifespan of adults is short. Therefore, it may be considered that this family is rather rare. The genus *Lycogaster* Shuckard, 1841 consists of 11 known species *L. angustula* Chen, Achterberg, He et Xu, 2014; *L. apicipennis* (Cameron, 1897); *L. celebesiensis* (Szepligeti, 1902); *L. flavonigrata* Chen, Achterberg, He et Xu, 2014; *L. heinrichi* Bischoff, 1933; *L. nigralba* Chen, Achterberg, He et Xu, 2014; *L. pullata* Shuckard, 1841; *L. rufiventris* (Magretti, 1897); *L. smithi* van Achterberg, 2015; *L. umbonata* Chen et van Achterberg, 2022; and *L. violaceipennis* Chen, 1949. Species in this genus are mainly distributed in the Nearctic region (*L. apicipennis* and *L. pullata*) and in the Oriental region (the other species) (Bischoff, 1933; Carmean & Kimsey, 1998; Chen *et al.*, 2014; Smith & Tripotin, 2015; Zhang *et al.*, 2022; Amal *et al.*, 2024). Not many hosts of *Lycogaster* are known to date. In North America, *L. apicipennis* has been reared from *Enicospilus* (Ichneumonidae, Hymenoptera) parasiting Notodontidae (Lepidoptera) (Carmean & Kimsey, 1998). In Asia, Smith & Tripotin (2015) stated that species of Asian *Lycogaster* seem to parasitize the Eumeninae through caterpillars.

In Vietnam, the only species of Trigonalysidae has been recorded for the country, namely *Orthogonalyx centrimaculta* Bischoff, 1951 (Bischoff, 1951; Carmean & Kimsey, 1998). In this present study, based on a large number of the specimens of *L. flavonigrata* collected in North Vietnam, we record the genus *Lycogaster* as new for the country and produce first notes on the biology of the species.

MATERIAL AND METHODS

The sampling was carried out from 2017 to 2025 at many localities of the following provinces in Vietnam: Cao Bang, Dien Bien, Hung Yen, Phu Tho, Son La, and Tuyen Quang. We used insect nets, nest-picking, trap nests, and Malaise traps to collect specimens. Mud nests of and trap nests occupied by wasps were collected in the field and transferred to the laboratory. The mud nests were intactly kept in plastic boxes (20×15×8 cm) or plastic jars (10×13 cm) to collect adult wasps as they emerged. The trap nests either were placed in plastic boxes (40×30×20 cm) to collect the emerging adults or were dissected to take nest contents. The nest contents were put in glass tubes (5–20 cm long and 0.5–1.2 cm in diameter) and also placed in plastic boxes (as above). The plastic boxes and jars were placed under eaves and bioassays were observed twice a week in winter and every day in summer. All adult wasps captured were killed with a killing jar charged with ethyl acetate, and then pinned. For Malaise traps, we used ethanol 90° for their collecting jars, and retrieved the specimens at 15 day intervals.

Adult morphological characters were observed from pinned and dried specimens with the aid of a stereoscopic microscope. The identification of the genus and species was carried out using the literature of Carmean & Kimsey (1998), Chen *et al.* (2014), and Smith & Tripotin (2015). Photographic images were taken using a Nikon SMZ800N microscope camera and a Canon SD3500 IS camera.

The specimens examined in the present paper are deposited in the Institute of Biology (IB), Vietnam Academy of Science and Technology, Ha Noi, Vietnam.

RESULTS AND DISCUSSION

Family Trigonalysidae Cresson, 1887

Genus *Lycogaster* Shuckard, 1841

Type species: *Lycogaster pullatus* Shuckard, 1841, by original designation.

COMPOSITION AND DISTRIBUTION. The genus consists of seven species known from India, China, Laos and Thailand.

Lycogaster flavonigrata Chen, Achterberg, He et Xu, 2014

Figs 1–8

Lycogaster flavonigrata Chen, Achterberg, He & Xu, 2014: 49.

MATERIAL EXAMINED. **Vietnam. Son La:** Son La, malaise trap, 1–15.IX 2017, 1♀, Long Dang Khuat leg. [IB]; Xuan Nha, 19.X 2023, 4♀, P. H. Pham leg., trap nests, adults emerged from these trap nests utilized by Eumeninae (Vespidae) between 5 and 11.V 2024, [IB]. **Diên Biên:** Sin Thau, 20.XII 2023, 2♀, P. H. Pham leg., emerged from one mud nest of possibly Eumeninae (Vespidae) 4–7.IV 2024 [IB]. **Phu Tho:** Yen Thuy, insect net, 3.VIII 2017, 1♀, P.H. Pham leg. [IB]; Tan Mai, insect net, 26.VII 2019, 1♀, P. H. Pham leg. [IB]; Luong Son, 26.VII 2019, 10.VIII 2019, 3♀, P. H. Pham leg., two trap nests, adults emerging between 1 and 9 IX 2019, [IB]. **Tuyen Quang:** Vi Xuyen, insect net, 25.V 2022, 1♀, P. H. Pham leg. [IB]; Quan Ba, insect net, 17.VI 2023, 1♀, P. H. Pham leg. [IB]. **Cao Bang:** Thanh Long, insect net, 13.VI 2023, 2♀, P. H. Pham leg. [IB]. **Hung Yen:** Tien Hai Wetland Nature Reserve, malaise trap, 3.VII 2025, 1♀, P. H. Pham leg. [IB].

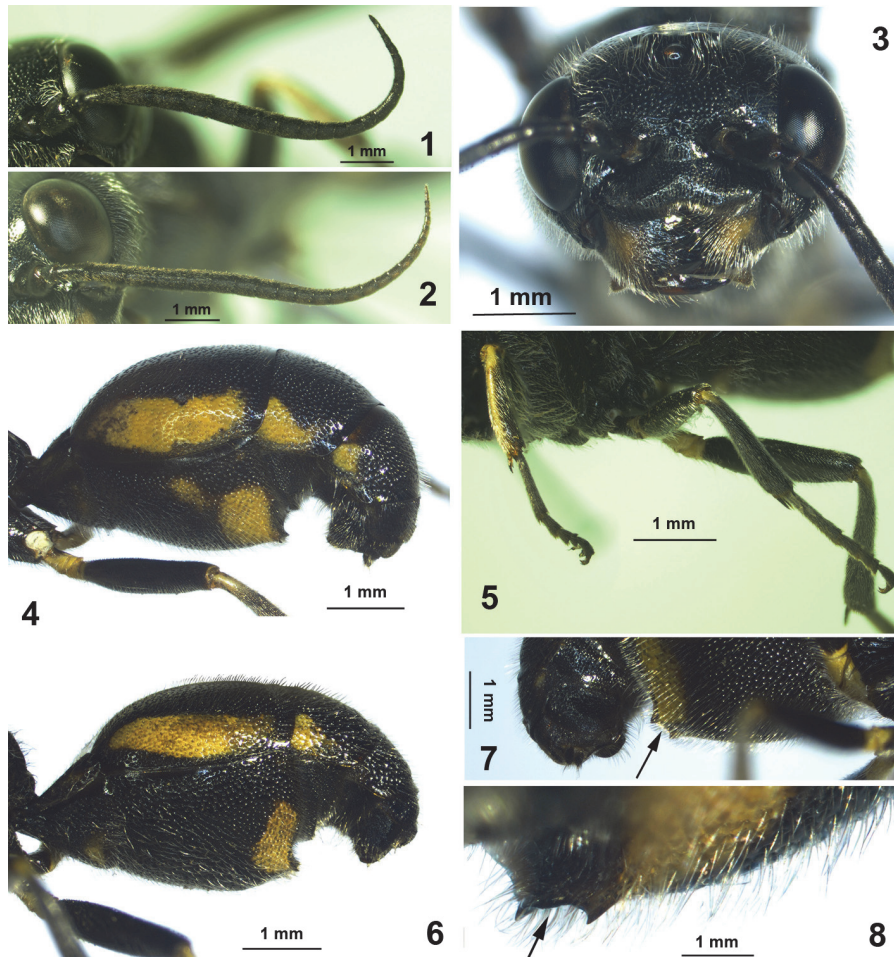
DIAGNOSIS. (see Chen *et al.*, 2014; Smith & Tripotin, 2015).

VARIABILITY. Morphological characters of the female collected in Vietnam agree with those recorded in China (Chen *et al.*, 2014), in Thailand and Laos by (Smith & Tripotin, 2015). However, *L. flavonigrata* in Vietnam has conspicuous variation of external morphological characters. For example, the number of antennal segments are 24 (Fig. 1) and 27 (Fig. 2) and yellow markings are on the mandibles in middle (Fig. 3); hind trochanters (Figs 4, 5); the base of each tibia (Figs 4, 5); metasomal tergites 1, 4, and 5 laterally (Figs 4, 6); and metasomal sternite 1 apically (Figs 4, 6). The metasomal sternite 2 has two pairs of yellow spots (Fig. 4). The base of outer, apical teeth of the mandibles is brown (Fig. 3). Metasomal tergites 2–5 are reddish brown. Lateral lobes of the mesoscutum were rather densely punctate. Frons with white medium-sized setae (Fig. 3). Lamellae of the protuberance near the second sternite apex are subtruncate (Fig. 7) or moderately convex (Fig. 8).

REMARKS. Although a large number of females are collected in this present study, males are unknown in this species suggesting that the sex ratio of *L. flavonigrata* is female-biased. Smith & Tripotin (2015) stated that *Lycogaster* were fairly rare in collections. Marsakov (1981) showed that there is considerable intraspecific variability in Trigonalysidae that has caused many species to be described repeatedly. It is quite probable that many of the currently recognised species are also synonyms. Carmean (1991) believed that sexual dimorphism in the family is one of difficulties to associate males and females of some genera. Variation of colour within a species may confuse identifications. Body size and the number of antennal segments are dependent on host size. In the present study, with large

variations of mutually mixed morphological characters among the specimens in *L. flavonigrata*, statements given by Marsakov (1981) and Carmean (1991) are documented and they may be applied to other Trigonalyidae to determine their synonyms.

BIOLOGY. Two nests of *Allorhynchium argentatum* (Fabricius, 1804) (Vespidae: Eumenine), which utilized trap nests made of hollow bamboo stems as its nesting sites, placed and collected in Luong Son district, Phu Tho province on 26 July and 10 August, 2019, respectively, were parasitized by *L. flavonigrata*. One 5 cell nest of the eumenine contained one paralyzed cell and the other 3 cell nest contained two. Three adult parasitoids emerged between 1 and 9 September 2019, all of them being females.



Figs 1–8. *Lycogaster flavonigrata* female from Vietnam. 1 – antenna with 24 segments; 2 – antenna with 27 segments; 3 – head, in frontal view; 4, 6 – metasoma, in lateral view; 5 – legs; 7 – protuberance near the second sternite apex with truncate lamella; 8 – protuberance near the second sternite apex with moderately convex lamella. Arrows show lamellae on the protuberance.

One 3 cell mud nest of a certain wasp, possibly an eumenine wasp (because no adult wasps of this host were collected), collected in Sin Thau commune, Dien Bien province on 20.XII 2023 emerged two adult parasitic wasps of *L. flavonigrata* between 4 and 7 April 2024.

A large number of more than 200 trap nests were placed in Xuan Nha commune, Son La province on 19 September 2023 and collected on 19 October 2023. 67 trap nests utilized by wasps were dissected on 5 November 2023. Three of them were utilized by *A. argentatum*, which constructed one with 2 cells (Figs 9, 10), one with 5 cells (Fig. 11), and one with 3 cells. At the time of dissection, we found the first nest containing one full developmental larva (Fig. 9) and one prepupa, the second nest containing two full developmental larvae and three prepupae, and the other with one full developmental larva and two prepupae. These prepupae maintained their overwintering until late March 2024, took pupation more than 10 days and emerged adult wasps of *A. argentatum* about the middle of April 2024. The larvae of the eumenine also remained their overwintering (Fig. 9), but from the ending of the March to the beginning of April 2024, larvae of *L. flavonigrata* consumed them and pupated after 15 April 2024. Four adult wasps of the trigonalid emerged between 5 and 11 May 2024 (Fig. 10) resulting in one 2 cell nest containing one trigonalid parasitoid (Fig. 10), one 5 cell nest with 2, and the other with one. Larvae of the eumenine were not completely consumed (Fig. 12). These results lead us to suggest that *L. flavonigrata* overwinters as larvae, possibly new hatched larvae or early staged larvae because during the winter, larvae of the host *A. argentatum* remained intactly (not fed by the parasitoid).



Figs 9–12. Nests and larvae of the *Allorhynchium argentatum* (Fabricius, 1804) host of *Lycogaster flavonigrata*. 9 – host larva parasitized by the trigonalid wasp; 10 – adult wasp of *L. flavonigrata* emerging; 11 – five cell trap nest used by the eumenine host; 12 – host larva consumed by the parasitoid.

Smith & Tripotin (2015) stated that species of Asian *Lycogaster* seem to parasitize the Eumeninae through caterpillars, somewhat like *Bareogonalos*. *Lycogaster* wasps are almost never found in traps set in forest but seem to research more sunny habitats where potter wasps nest, and therefore are likely to have a much better resistance to desiccation than the other Trigonalids. In this present study, trap nests used by *A. argentatum* and the mud nest of one certain eumenine were collected from only forest edges and sunny habitats. Hence, it is clear that our findings consolidate their statements.

Adult wasps of *L. flavonigrata* emerged in May and September in the present study [collected in April and May (see Smith & Tripotin, 2015) and in April, July, August, October (see Chen *et al.*, 2014)] and used only mud nest-constructing Eumeninae hosts (in the present

study) suggesting that the Trigonalid has more than one generation per year and limitation of its distribution and the size of population, respectively. For the latter issue, it is why *L. flavonigrata* is rare in collections as Smith & Tripotin (2015) have stated.

DISTRIBUTION. Vietnam: Cao Bang, Dien Bien, Hung Yen, Phu Tho, Son La, Tuyen Quang (new record); China, Laos, Thailand (Chen *et al.*, 2014; Smith & Tripotin, 2015).

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REFERENCES

- Bischoff, H. 1933. Beiträge zur Kenntnis der Trigonaloiden. *Mitteilungen aus dem Zoologischen Museum in Berlin*, 19: 480–496.
- Bischoff, H. 1951. Über einige Trigonaloiden des British Museum (Natural History) (Hymenoptera). *Annals and Magazine of Natural History*, 12(4): 908–914.
- Carmean, D. 1991. Biology of the Trigonalidae (Hymenoptera), with notes on the vespine parasitoid *Bareogonals canadensis*. *New Zealand Journal of Zoology*, 18: 209–214. DOI: 10.1080/03014223.1991.10757968
- Carmean, D. & Kimsey, L. 1998. Phylogenetic revision of the parasitoid wasp family Trigonalidae (Hymenoptera). *Systematic Entomology*, 23: 35–76. DOI: 10.1046/j.13653113.1998.00042.x
- Chen, H.Y., van Achterberg, C., He, J.H. & Xu, Z.F. 2014. A revision of the Chinese Trigonalidae (Hymenoptera, Trigonalidae). *ZooKeys*, 385: 1–207. DOI: 10.3897/zookeys.385.6560
- Kumar, G.P. & Hegde, V.D. 2023. Additions to the knowledge of Taeniogonals Schulz, 1906 (Hymenoptera: Trigonalidae) from India with the description of a new species from Western Ghats. *Zootaxa*, 5361(4): 566–572. DOI: 10.11646/zootaxa.5361.4.6
- Lelej, A. S. 2019. Family Trigonalidae (Trigonalidae) – Trigonalid wasps. P. 28–29. In: Belokobyl'skij, S.A.; Samartsev, K.G. & Il'inskaya, A.S. (Eds). *Annotated catalogue of the Hymenoptera of Russia. Volume II. Apocrita: Parasitica*. Proceedings of the Zoological Institute Russian Academy of Sciences, Supplement 8, St Petersburg.
- Marshakov, V.G. 1981. Trigonalidae (Hymenoptera) of the USSR fauna. P. 100–107. In: Korotyaev, B.A. (Ed.). *Morphology and Systematics of insects of the Far East*. Nauka, Leningrad. [In Russian]
- Amal, S., van Achterberg, C., Kumar, A.R. & Kumar, G.P. 2024. Range extension of the genus *Lycogaster* Shuckard, 1841 (Hymenoptera: Trigonalidae) to India with the species *L. rufiventris* (Magretti, 1897) from Northeastern India. *Zootaxa*, 5541(2): 241–244. DOI: 10.11646/zootaxa.5541.2.9
- Smith, D. R. & Tripotin, P. 2015. Trigonalidae (Hymenoptera) of Thailand, other southeastern Asian records, and a new Trigonalid from India. *Journal of Hymenoptera Research*, 44: 1–18. DOI: 10.3897/JHR.44.4495
- Zhang, B.L., Yan, C. J., van Achterberg, C., Peng, Y.Q. & Chen, H.Y. 2022. Integrated taxonomy unveils new species of Trigonalidae (Insecta, Hymenoptera) from Yunnan, China. *Journal of Hymenoptera Research*, 90: 101–128. DOI: 10.3897/jhr.90.80150