



Phanuromyia ricaniae Nam, Lee & Talamas sp. n. (Hymenoptera: Scelionidae) reared from the eggs of *Ricania shantungensis* Chou & Lu (Hemiptera: Ricaniidae) in Asia

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Abstract

The genus *Phanuromyia* in the subfamily Telenominae (Hymenoptera: Scelionidae) consists of 60 described species, for which host records indicate they are egg parasitoids of lanternflies and planthoppers (Hemiptera: Auchenorrhyncha). In this study, we describe a new species of the genus, *P. ricaniae* sp. n., reared from the eggs of a planthopper, *Ricania shantungensis* Chou & Lu (Hemiptera: Ricaniidae). This planthopper has been considered as a serious invasive pest in South Korean agriculture. *Ricania shantungensis* has a wide host range, including economically important crops such as apple, peach, and pear. *Phanuromyia ricaniae* therefore has the potential to be a biological control agent against ricaniid planthoppers.

Key words: Biological control, *Ricania*, Platygastroidea, *Phanuromyia*

Introduction

Ricania shantungensis Chou et Lu was first described feeding on persimmon and hawthorn trees from Shandong province of China in 1977 and subsequently considered as an important pest of fruit and ornamental trees (Chou and Lu, 1977; Shen et al., 2007). In 2010, this pest was found in South Korea, and identified as *Ricania* sp. (Choi et al., 2012). The species was later confirmed as *R. shantungensis* (Figure 1) and has been recognized as a pest of growing concern as it spreads throughout South Korea, where it is now known from 43 cities and counties (Kwon et al., 2017). Over 110 tree species in 53 families have been recorded as host plants, including agriculturally important crops and fruit trees (Kim et al., 2015). Damage to host plants is caused by the sucking of fluids, egg-laying (Figure 2), and excretions that can induce sooty mold disease on the leaves (Choi et al., 2012).

In South Korea, an egg parasitoid of *R. shantungensis* was first reported as a member of the genus *Telenomus* Haliday (Scelionidae: Telenominae) from Gurye-gun, Jeollanam-do, in September 2015 (reared by GSL). This

parasitoid species has since been found in several areas of Jeonnam province, including Muan, Suncheon, Gwangju, and Goksung (Choi et al., 2018). In China, egg parasitoids were reared from an undetermined ricaniid planthopper species feeding on tea trees in Anhui province in 2017 (reared by WD) and from *R. shantungensis* in Shandong province in 2018 (reared by LJS). On examination of the specimens from Korea and China, we found that these parasitoids are conspecific and belong to the telenomine genus *Phanuromyia* Dodd based on characters presented in Johnson & Musetti (2003), most notably the right angle formed between the malar sulcus and the margin of the compound eye.



FIGURE 1–2. 1 Ricanid planthopper (*Ricania shantungensis*), lateral view 2 Eggs of ricaniid planthopper.

With 60 described species, *Phanuromyia* is a moderately large genus, and one that is projected to contain many undescribed species. It is distributed worldwide, and its members are known to parasitize the eggs of Auchenorrhyncha (Hemiptera), including Issidae, Fulgoridae and Flatidae (Johnson & Musetti, 2003, Nesheim et al., 2017). Here, we describe a new species of *Phanuromyia* attacking the eggs of *R. shantungensis* from South Korea and China, which is a potential biological control agent of ricaniid planthoppers.

Materials and methods

This work is based upon specimens in the following collections, with abbreviations used in the text:

CNCI	Canadian National Collection of Insects, Ottawa, Ontario, Canada
FSCA	Florida State Collection of Arthropods, Gainesville, Florida, USA
SNU	College for Agriculture and Life Sciences, Seoul National University, Seoul, Korea
SYSBM	Sun Yat-sen University, The Museum of Biology, Guangzhou, China.

Specimen records are deposited in Hymenoptera Online (<http://hol.osu.edu>). Terminology of morphological traits follows Mikó et al. (2007) and Talamas et al. (2017). Extended-focus images were taken with a Leica Z16 APO lens with a Leica DMC5400 camera with Leica X software. Scanning electron micrographs were produced using Phenom Pro Desktop SEM and aligned in Helicon focus.

Sequence data

To confirm morphological identifications, genomic DNA was extracted from a specimen collected in Gurye, South Korea, and two specimens collected in China, Shandong and Anhui provinces. A nondestructive DNA extraction protocol was used, as described in Taekul et al. (2014), to enable preservation of a voucher specimen. Genomic DNA was extracted using a DNeasy Blood & Tissue Kit (QIAGEN, Inc.) and LCO1490 and HCO2198 primers (Folmer et al., 1994) were used to amplify the “barcode” region of the mitochondrial cytochrome oxidase subunit 1 (COI). Amplicons were sequenced on an Applied Biosystems (ABI) 3730XL by Sangon Biotech (Shanghai, China). Chromatograms were assembled with Geneious 11.0.3. All the amplified sequences were deposited into GenBank (accession numbers: MN650032, MN650033, MN650034). The three sequences were aligned and compared in Geneious 11.0.3 using the MAFFT alignment algorithm. Voucher specimens for all molecular data are deposited in SNU and SYSBM.

Abbreviations used in figures are as follows:

- pss**: pronotal suprahumeral sulcus
- epc**: epomial carina
- net**: netrion
- nes**: netrion sulcus
- str**: sternaulus
- spec**: speculum
- mc**: mesopleural carina
- pcxs**: paracoxal sulcus
- shms**: mesoscutal suprahumeral sulcus
- mshs**: mesoscutal humeral sulcus

Results

Phanuromyia ricaniae Nam, Lee & Talamas, sp. n.

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https://bioguid.osu.edu/xbioid_concepts/509748

Figures 3–18



Figure 3. *Phanuromyia ricaniae* sp. n., holotype, female (SNUP0010003), habitus, dorsal view.

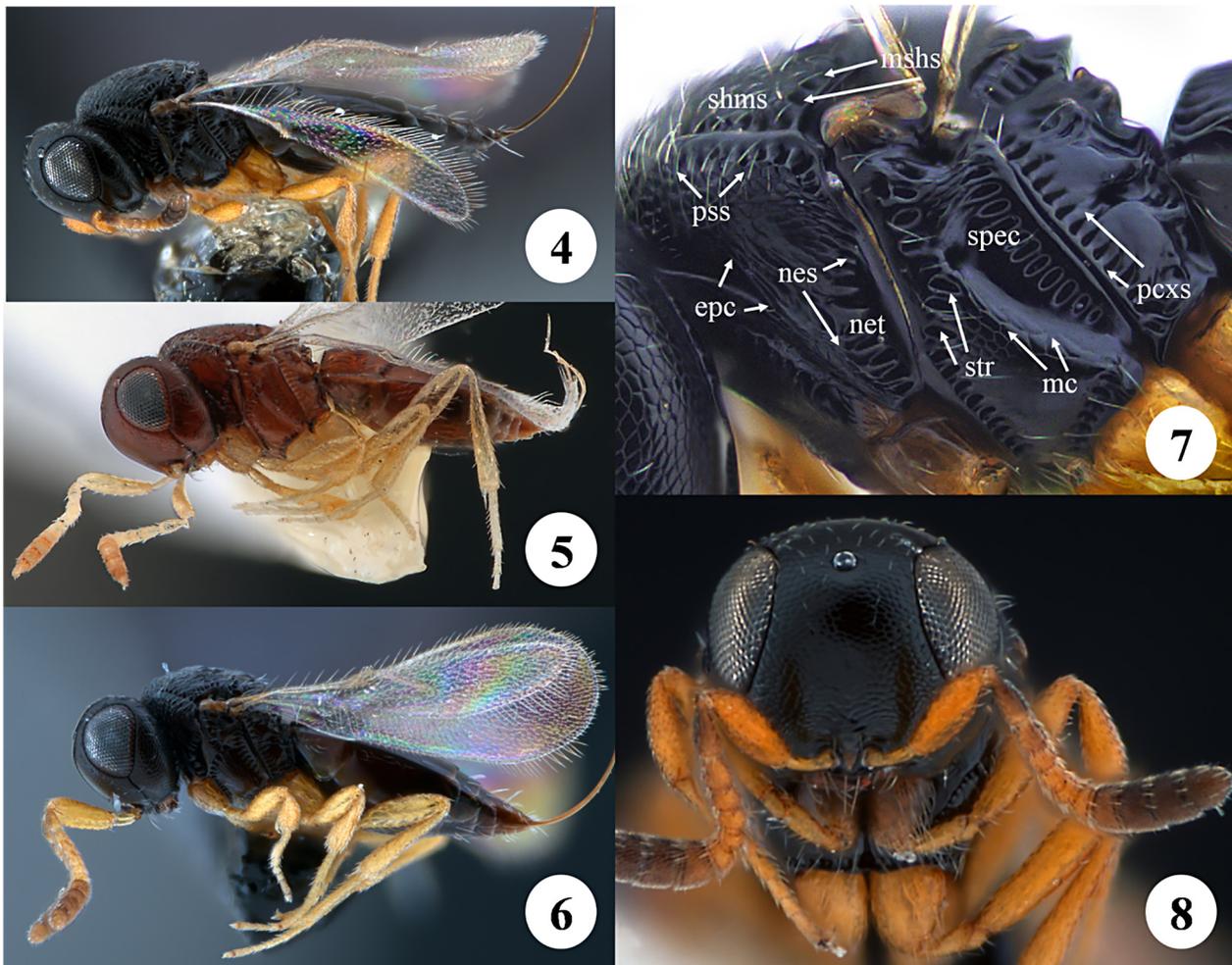


FIGURE 4–8. *Phanuromyia ricaniae* sp. n. **4** Female (SNUP0010018), habitus, lateral view **5** Female (SNUP0010004), habitus, lateral view **6** Female (SNUP0010019), habitus, lateral view **7** Female (SNUP0010003), mesosoma, lateral view **8** Female (SNUP0010003), head, anterior view.



FIGURE 9–11. *Phanuromyia ricaniae* sp. n., paratype, male (SNUP0010001) **9** Head and antennae, lateral view **10** Habitus, dorsal view **11** Habitus, lateral view.

Description. Color of body: light brown to black. Female body length: 0.9–1.09 mm (n=22). Male body length: 0.9–1.06 mm (n=13).

Head. Claval formula: 1-2-2-1. Shape of clypeus: convex, with obtuse point medially. Number of clypeal setae: 6. Central keel: absent. Antennal scrobe: absent, undifferentiated from remainder of frons. Sculpture of frons: reticulate microsculpture. Sculpture of gena: reticulate microsculpture. Setation of compound eye: absent. Position of lateral ocellus: contiguous with compound eye. Shape of vertex: broadly rounded. Anterior margin of occipital carina: weakly crenulate. Hyperoccipital carina: absent.

Mesosoma. Epomial carina: present, short and often obscured by head in lateral view. Pronotal cervical sulcus: present as a smooth furrow. Sculpture of lateral pronotal area: obliquely rugose. Pronotal suprahumeral sulcus: indicated by punctures. Netrion sulcus: foveate, complete dorsally. Prespecular sulcus: foveate, extending from subalar pit to mesopleural pit. Sculpture of speculum: transversely rugulose. Anterior mesepisternal area: present as an elevated, smooth area. Sculpture of femoral depression: smooth. Mesopleural carina: absent. Episternal foveae: present, forming a continuous line with foveae of postacetabular sulcus that extends to mesopleural pit. Postacetabular sulcus: comprised of distinct foveae. Sculpture of anteroventral mesopleuron: with microsculpture directly ventral to femoral depression, otherwise smooth. Mesopleural epicoxal sulcus: foveate. Posterior mesepimeral area: narrow, present as a strip of lesser width than mesepimeral sulcus. Paracoxal sulcus: foveate, present along entire anterior margin of metapleuron. Transverse portion of metapleural sulcus: indicated by furrow extending to the anterior and posterior margins of the metapleuron. Sculpture of ventral metapleural area: smooth. Sculpture of dorsal metapleural area: smooth. Microsculpture of mesoscutum: reticulate microsculpture. Notaulus: absent. Mesoscutal suprahumeral sulcus: present as a distinct line of cells. Mesoscutal humeral sulcus: present as a distinct line of foveae. Sculpture of mesoscutellum: smooth, sometimes with reticulate microsculpture laterally. Metascutellum: line of foveae. Sculpture of metanotal trough: foveate. Length of postmarginal vein: about 3 times as long as stigmal vein. Length of marginal vein: short, about 1/4 length of stigmal vein. Sculpture of lateral propodeal area: foveate along anterior margin of lateral propodeal carina. Sculpture of metasomal depression: with line of fovea along periphery and surrounding propodeal foramen, otherwise smooth.

Metasoma. Sculpture of T1 between basal costae and median band of foveae: striate between basal costae and median band of foveae, striae sometimes incomplete medially. Median band of foveae on T1: present. Sculpture of T1 posterior to median band of foveae: smooth. Setation of laterotergite 1: present as a patch in anterodorsal portion.

Sculpture of T2 posterior to basal foveae: longitudinally strigose, reticulate posteriorly. Setation of laterotergite 2: present along dorsal margin. Sculpture of T3–T5: covered in cuticular pores, otherwise smooth. Setation of T3–T7: with sparse, long setae. Sculpture of S2: longitudinally striate. Sculpture of S3–S4: covered in cuticular pores, otherwise smooth. Setation of S3–S6: with long setae laterally.

Etymology. The epithet “ricaniae” is the genitive case form of *Ricania*, the genus from which this species has been reared.

Material Examined. Holotype, female: **SOUTH KOREA:** Dong-gu Daejeon, Jungang-ro, 36°19'56.3"N 127°26'02.5", Daejeon St. 215, 8.VIII.2016, sweeping, S. Nam, SNUP0010003 (deposited in SNU). Paratypes: (63 females, 12 males) **CHINA:** 44 females, 10 males, SCAU 3040575–3040583, 3048582–3048583 (SYSBM), SCAU 3044143–3044185 (SYSBM) **SOUTH KOREA:** 19 females, 2 males, CNC1558300–CNC1558302 (CNCI); SNUP0010001–SNUP0010002, SNUP0010004–SNUP0010019 (SNU).

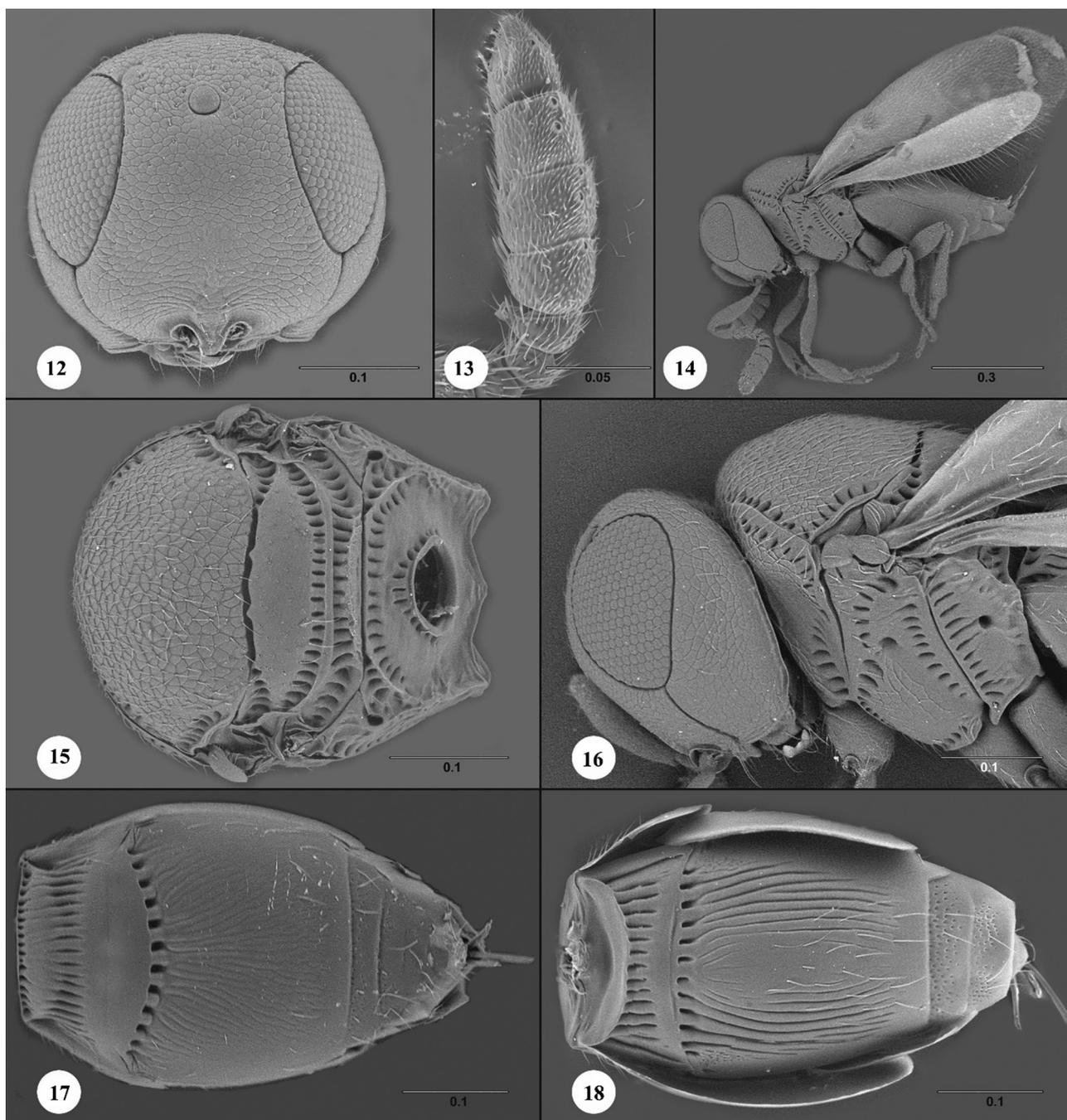


FIGURE 12–18. *Phanuromyia ricaniae* sp. n., paratype, female (SCAU 3048583) **12** Head, anterior view **13** Antennal clava, ventral view **14** Habitus, lateral view **15** Mesosoma, dorsal view **16** Head and mesosoma, lateral view **17** Metasoma, dorsal view **18** Metasoma, ventral view. Scale bar in millimeter.



FIGURE 19–21. *Phanuromyia flaviventris* (Kozlov & Kononova), holotype, female **19** Habitus, lateral view **20** Habitus, dorsal view **21** Head, anterior view.

Diagnosis. In the absence of a large-scale revision of Asian *Phanuromyia*, we compared *P. ricaniae* to the images of *Phanuromyia* species presented in Veenakumari & Mohanraj (2014) and Veenakumari & Mohanraj (2019), the description of *P. bidentata* by Johnson & Musetti (2003), and holotype images of three other Asian species: *P. flaviventris* (Kozlov & Kononova) (Figs 19–21), *P. nioba* (Kozlov & Kononova) (Figs 22–25), and *P. marshakovi* (Kozlov & Kononova) (Figs 26–29). Among these, *P. ricaniae* is most similar to *P. andamanensis* and *P. nabakovi* Veenakumari, which share a similar pattern of mesosomal sulci, coloration, and surface sculpture. *Phanuromyia ricaniae* and *P. andamanensis* can easily be separated by the length of striae on S2. These striae extend nearly to the end of the sternite in *P. ricaniae* and are only half the length of the sternite in *P. andamanensis* (see Figure 8 in Veenakumari & Mohanraj 2014). Separating *P. ricaniae* from *P. nabakovi* is less straightforward because the sculpture of S2 is not described or illustrated in Veenakumari & Mohanraj (2014). Figure 29 in Veenakumari & Mohanraj (2014) illustrates a paracoxal sulcus comprised of very small foveae that are small and poorly defined, particularly in the ventral half of the metapleuron whereas in *P. ricaniae* these foveae are robust and tend to be elongate. Metasomal tergite 1 is described as “weakly costate” in *P. nabakovi* and an image of the holotype illustrates that T1 is smooth medially (Fig. 30). Metasomal tergite 1 in *P. ricaniae* is variable in the degree to which it is dorsally humped in lateral view and in the size of the posterior smooth area, but the costae that transversely bisect the tergite are consistently distinct.

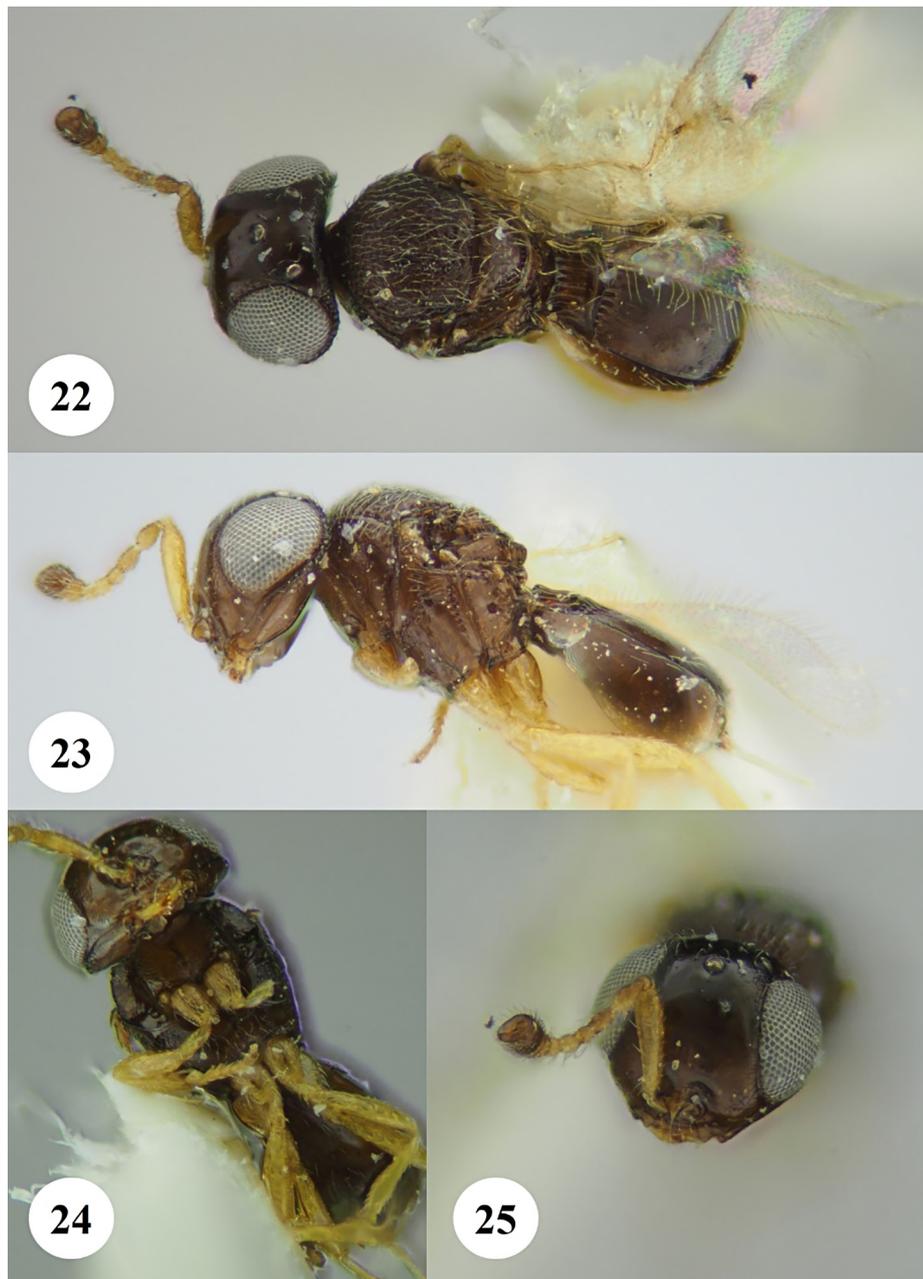


FIGURE 22–25. *Phanuromyia nioba* (Kozlov & Kononova), holotype, female 22 Habitus, dorsal view 23 Habitus, lateral view 24 Habitus, ventral view 25 Head, anterior view.

COI sequence results

The COI sequences are over 98% identical among specimens sampled from the three collecting localities (Table 1), indicating the populations from China and South Korea are conspecific.

Table 1. Pairwise distances (% identity) of *COI* sequences within three populations of *Phanuromyia*

	<i>P. ricaniae</i> Shandong	<i>P. ricaniae</i> Anhui	<i>P. ricaniae</i> Korea
<i>P. ricaniae</i> Shandong		99.70%	98.80%
<i>P. ricaniae</i> Anhui	99.70%		99.10%
<i>P. ricaniae</i> Korea	98.80%	99.10%	

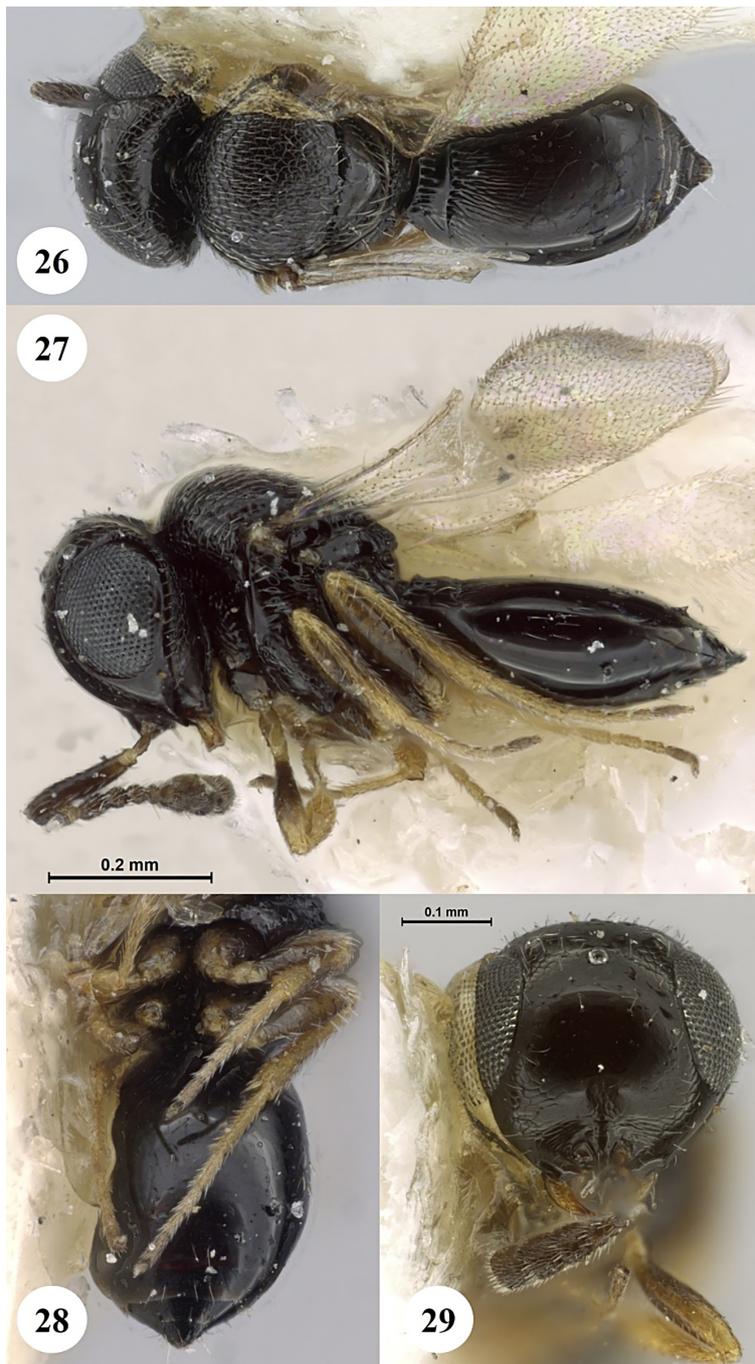


FIGURE 26–29. *Phanuromyia marshakovi* (Kozlov & Kononova), holotype, female 26 Habitus, dorsal view 27 Habitus, lateral view 28 Metasoma, ventral view 29 Head, anterior view.



FIGURE 30. *Phanuromyia nabakovi* Veenakumari, holotype, female 30 Metasoma, dorsal view.

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