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Description of a new species of the genus *Atanycolus* Foerster (Hymenoptera: Braconidae) parasitizing *Lamprodila nobilissima bellula* (Lewis) (Coleoptera: Buprestidae) in China

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Abstract

Atanycolus yangi sp. nov. (Hymenoptera, Braconidae), a new species parasitizing the flatheaded wood borer, *Lamprodila nobilissima bellula* (Lewis) (Coleoptera: Buprestidae), is described. *Lamprodila nobilissima bellula* is a serious wood boring pest of Rosacea trees in North China. We collected adult specimens of *A. yangi* sp. nov. searching for hosts on infested tree trunks and confirmed the host-parasitoid association by dissecting parasitized hosts from infested trees in the field and rearing the parasitoid from *L. nobilissima bellula* -infested host tree logs in the laboratory. Adult images for both sexes of the new parasitoid species are provided. A morphological identification key to Oriental and Palaearctic species similar to *A. yangi* sp. nov is also presented.

Key words: braconid, natural enemy, woodborer, biocontrol agent, solitary

Introduction

Lamprodila nobilissima bellula (Lewis) (Coleoptera: Buprestidae) is a woodborer on fruit and forest trees in North China, and attacks various trees in the Rosaceae (*Crataegus pinnatifida*, *Malus asiatica*, *M. domestica*, *Prunus armeniaca*, *P. persica*, *P. pseudocerasus*, *Pyrus* spp.), Ulmaceae (*Ulmus pumila*), and Rhamnaceae (*Ziziphus jujuba*) (Wang et al. 2018). Among the hosts of *L. nobilissima bellula*, *P. persica* has been widely planted in municipalities across Beijing City, Tianjin City, and Hebei Province. As a result, peaches produced by *P. persica* have become one of the main summer fruits produced in North China. With this recent expansion of peach plantations in North China various insect pests have become increasingly serious, especially in older plantings (Fig. 1).

In 2023, we conducted surveys of peach pests and their associated parasitoids in the Beijing area. Initially, our goal was to identify effective parasitoids for biological control of *Aromia bungii* (Faldermann) (Coleoptera: Cerambycidae), which is a major woodborer pest of peach trees and is considered a high-risk invasive pest in other regions (CABI 2019). During the surveys, however, we determined that *L. nobilissima bellula,* rather than *A. bungi,* was causing the most damage to *P. persica* plantings in the Beijing area (Figs 2–4). We did not find any parasitoids in surveys of pesticide-treated peach orchards; however, in organic peach orchards and recreational parks, we frequently observed multiple adult wasp parasitoids hovering over infested peach tree trunks and/or drilling into trunks with their ovipositors. One of the common parasitoids was identified as a species in the genus *Atanycolus.*

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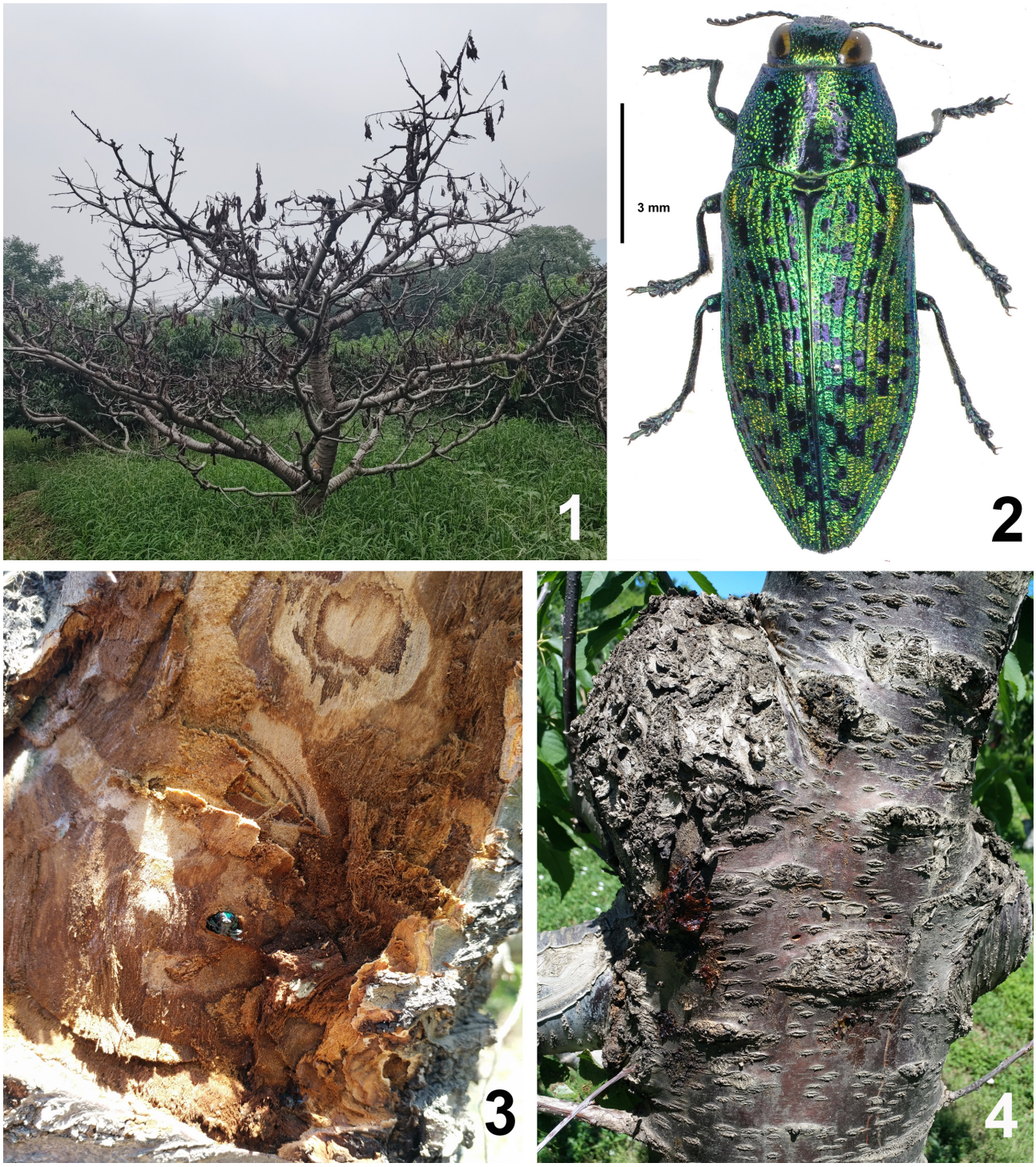


FIGURES 1–4. 1, Dead peach tree (*Prunus persica*) infested by *Lamprodila nobilissima bellula* and *Aromia bungii*. 2, Habitus of *L. nobilissima bellula*. 3, Trunk of *P. persica* damaged by *L. nobilissima bellula*. 4, Exterior trunk of *P. persica* with damage by *L. nobilissima bellula* (photo credit for 1–2: first author; 3–4: Yan-long Zhang, Ecology and Nature Conservation Institute, Chinese Academy of Forestry).

Atanycolus Foerster, one of the major genera in the subfamily Braconinae, contains 66 valid species and 3 subspecies worldwide, including 37 Nearctic species, 12 Palearctic species, 10 Oriental species, five Afrotropical species, two Neotropical species and two Australasian species (Table 1) (Yu et al. 2016, Li et al. 2020, Ahmed et al. 2022). Like the vast majority of braconid woodborer parasitoids, *Atanycolus* species are idiobiont ectoparasitoids of xylophagous and stem-boring coleopteran larvae. Each of the known *Atanycolus* species are almost always restricted

to one biogeographical region, their host ranges are quite multifarious so far as is known, such as *A. simplex* has a wide host range in N. America, and *A. longicauda* has the only one host record (*Agrilus planipennis*) in same area (Yu et al. 2016). Most species in this genus are still lack of host information or poorly studied on host region. The only exceptions are *A. denigrator* (L.) and *A. initiator* (F.); the former species is distributed in both Palearctic and Afrotropical regions while the latter species is distributed in both Palearctic and Oriental regions, and both species have wide host ranges (Yu et al. 2016). Here, we report a newly discovered *Atanycolus* species of the buprestid *L. nobilissima bellula* in China.

Materials and methods

Adult specimens of the new *Atanycolus* species were examined under a Nikon SMZ1500 stereomicroscope, and the morphology of the new species was described based on naturally dried specimens. Images of fresh specimens were taken with an Olympus CX31 microscope, supplemented by the "UV-C Optical Totally Focuses System" (Beijing United Vision Technology Co. Ltd., China). Terminology follows van Achterberg (1993) and Li et al. (2020). Measurements were obtained using a calibrated micrometer. Type specimens are deposited in the Natural History Museum of the Chinese Academy of Forestry, Beijing, China. Abbreviations used in descriptions follow those by Belokobylskij and Maeto (2009): POL = postocellar line, OD = ocellar diameter, OOL = ocellar-ocular line. Identification of the new species is based on the key and and original description of *A. lindemani* (Tobias 1980) as well as adult images provided by Li et al. (2020).

Taxonomy

Genus *Atanycolus* Foerster, 1863

Atanycolus Foerster, 1863: 238 (name published in key, type species); Dalla Torre, 1898: 295 (catalogue); Ashmead, 1900: 138 (in key); Szépligeti, 1904: 18 (catalogue, distribution); Roman, 1910: 112 (diagnosis); Viereck, 1914: 16 (type species); Fahringer, 1926: 116 (diagnosis, key to species); Telenga, 1936: 26 (in key); Watanabe, 1937:13 (key to species of Japan, hosts); Shenefelt, 1943: 51 (history, key to species of North America); Granger, 1949: 18 (in key); Papp, 1960: 368, 377 (in key, key to species); Baltazar, 1962: 768 (in key); Mason, 1978: 722 (in key); Shenefelt, 1978: 1437 (catalogue, hosts); Marsh, 1979: 159 (catalogue of North America and Mexico); Marsh et al., 1987: 41 (in key); Quicke & Sharkey, 1989: 339, 345 (in key, notes, hosts); Wang et al., 2009: 32 (key to species of China); Li et al., 2020: 5 (key to species of China, diagnosis). **Type species.** *Ichneumon denigrator* Linnaeus, 1758.

Coelobracon Thomson, 1892: 1787 (name published in key (*manipulus*), type species assigned); Dalla Torre, 1898: 295 (synonymized). **Type species:** *Ichneumon denigrator* Linnaeus, 1758.

Melanobracon Ashmead, 1900: 138 (new genus described in key, type species assigned); Szépligeti, 1904: 18 (synonymized). **Type species:** *Bracon simplex* Cresson, 1872.

Atanycolidea Viereck, 1912: 617 (new genus, type species assigned); Shenefelt, 1943: 56 (synonymized). **Type species:** *Bracon rugosiventris* Ashmead, 1889.

Diagnosis. Recognized within *Atanycolus* by the following combination of characters. Body medium–large sized. Scape highly modified and subcylindrical, base ventrally chamfer-shaped, apex ventrally expanded forward, bilaterally concave. Vein 1-SR+M of fore wing more or less straight, sometimes curved weakly. A single thickened basal bristle located at 1/5 of basal hind wing. First metasomal tergite divided into three parts, usually with different colors, the median part somewhat dark colored, second metasomal tergite with three smooth areas medio-basally and bilateral-basally. Ovipositor sheath longer or equal to body length. Hosts are woodborers of Buprestidae, Cerambycidae, and Curculionidae**.**

TABLE 1. Valid species and distributions of the genus *Atanycolus* worldwide.

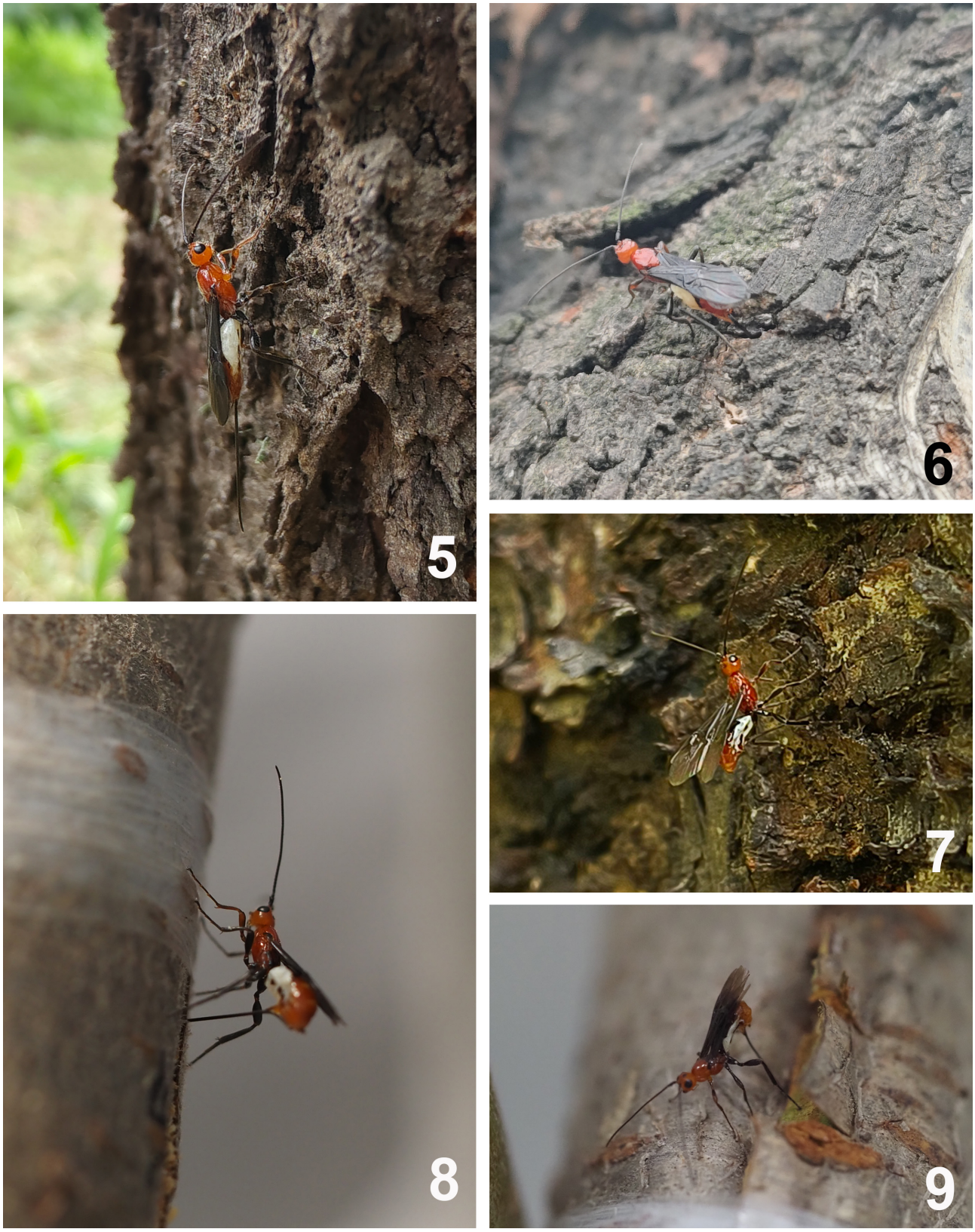
Name	Distribution	Name	Distribution
anocomidis Cushman,1931	N. America	*lindemani* Tobias, 1980	China, Mongolia, Russia
arcasuturalis Shenefelt, 1943	USA	*lineola* (Brullé, 1846)	N. America
australiensis Quicke & Ingram, 1993	Australia	*lissogastrus* Shenefelt, 1943	N. America
bambalio Schulz, 1906	Bioko Is.	*longicauda* Shenefelt, 1943	N. America
bignelli (Brues, 1918)	Solomon Is.	*longifemoralis* Shenefelt, 1943	N. America
calophrys Shenefelt, 1943	N. America	*longiquus* Li, He & Chen, 2020	China
cappaerti Marsh & Strazanac, 2009	USA	*maculipennis* Li, He & Chen, 2020	China
charus (Riley, 1875)	N. America	*malii* Shenefelt, 1943	USA
clypealis Granger, 1949	Madagascar	*megophthalmus* Shenefelt, 1943	USA
comosifrons Shenefelt, 1943	USA	*melanophili* Shenefelt, 1943	USA
carinatus Li, He & Chen, 2020	China	*microcellus* Shenefelt, 1943	Canada
crassicruris Shenefelt, 1943	USA, Mexico	*microstigmatus* Shenefelt, 1943	USA
crenulatus Telenga, 1936	China, Russia	*montivagus* (Cresson, 1865)	USA, Mexico
cryptaspis Shenefelt, 1943	USA	*neesii* (Marshall, 1897)	Palearctic
denigrator (Linnaeus, 1758)	Palearctic, Afrotropical	*nigriventris* Vojnovskaja-Krieger, 1935	Russia
dichrous (Brullé, 1846)	USA	*nigropyga* Shenefelt, 1943	USA
disputabilis (Cresson, 1865)	USA	*niteofrons* Shenefelt, 1943	USA
fahringeri Shenefelt, 1978	D. R. Congo, Tanzania	*obliquus* (Provancher, 1880)	Canada
femoratae Shenefelt, 1943	USA	*octocolae* Shenefelt, 1943	USA
fulviceps (Kriechbaumer, 1898)	Europe	*parvacavus* Shenefelt, 1943	USA
fulvus Tobias, 1974	Mongolia	*peruvianus* Szépligeti, 1906	Peru
fuscipennis (Cameron, 1902)	Malaysia	*petiolaris* (Thomson, 1892)	Germany
fuscorbitalis Shenefelt, 1943	USA	*phaeostethus* Shenefelt, 1943	USA
genalis (Thomson, 1892)	Palearctic	*picipes* (Cresson, 1865)	Cuba
grandis Wang & Chen, 2009	China	*pilosiventris* Shenefelt, 1943	USA, Canada
hicoriae Shenefelt, 1943	USA	*rugosiventris* (Ashmead, 1889)	USA
hookeri (Cameron, 1907)	India	*simplex* (Cresson, 1872)	N.America, Mexico
impressifrons Shenefelt, 1943	USA	*setosus* Li, He & Chen, 2020	China
impressus (Szépligeti, 1908)	Afrotropical	*tangmargensis* Ahmed & Kazmi, 2022	India
initiator (Fabricius, 1793)	Palearctic, Oriental	*tranquebaricae* Shenefelt, 1943	Bahamas, USA
subsp. *nigrinus* (Fahringer, 1926)	Europe	*triangulifer* (Viereck, 1907)	USA
subsp. *rubromaculatus* (Fahringer, 1926)	Austria	*trichiura* (Cameron, 1902),	Malaysia
subsp. *temporalis* (Kokujev, 1898)	Poland	*tunetensis* (Marshall, 1899)	Italy, Tunisia
ivanowi (Kokujev, 1898)	Palearctic	*ulmicola* (Viereck, 1906)	USA, Canada
latabdominalis Shenefelt, 1943	USA		

Atanycolus yangi Cao, Xie *et* Wang, sp. nov.

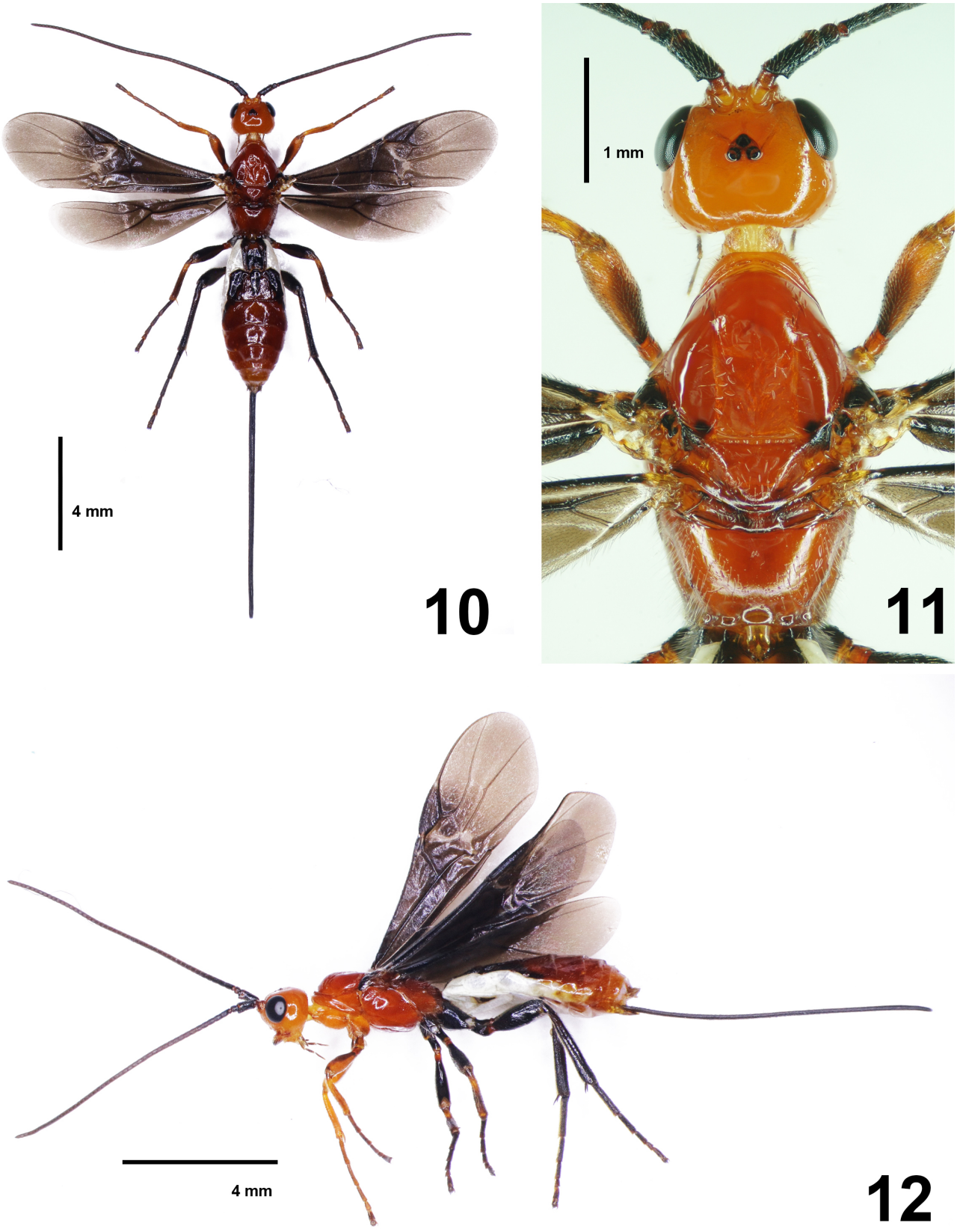
(Figs 5–25)

Type materials. Holotype, 1♀, China, Beijing City, Haidian District, Minzhuang Road, N39°58′15″, E116°12′45″, 11.vii.2023, collected when it was searching for hosts on a trunk of *P. persica*, Xie Ji-yu & Cao Liang-ming leg. **Paratypes,** 4♀♀4♂♂, same data as the holotype.

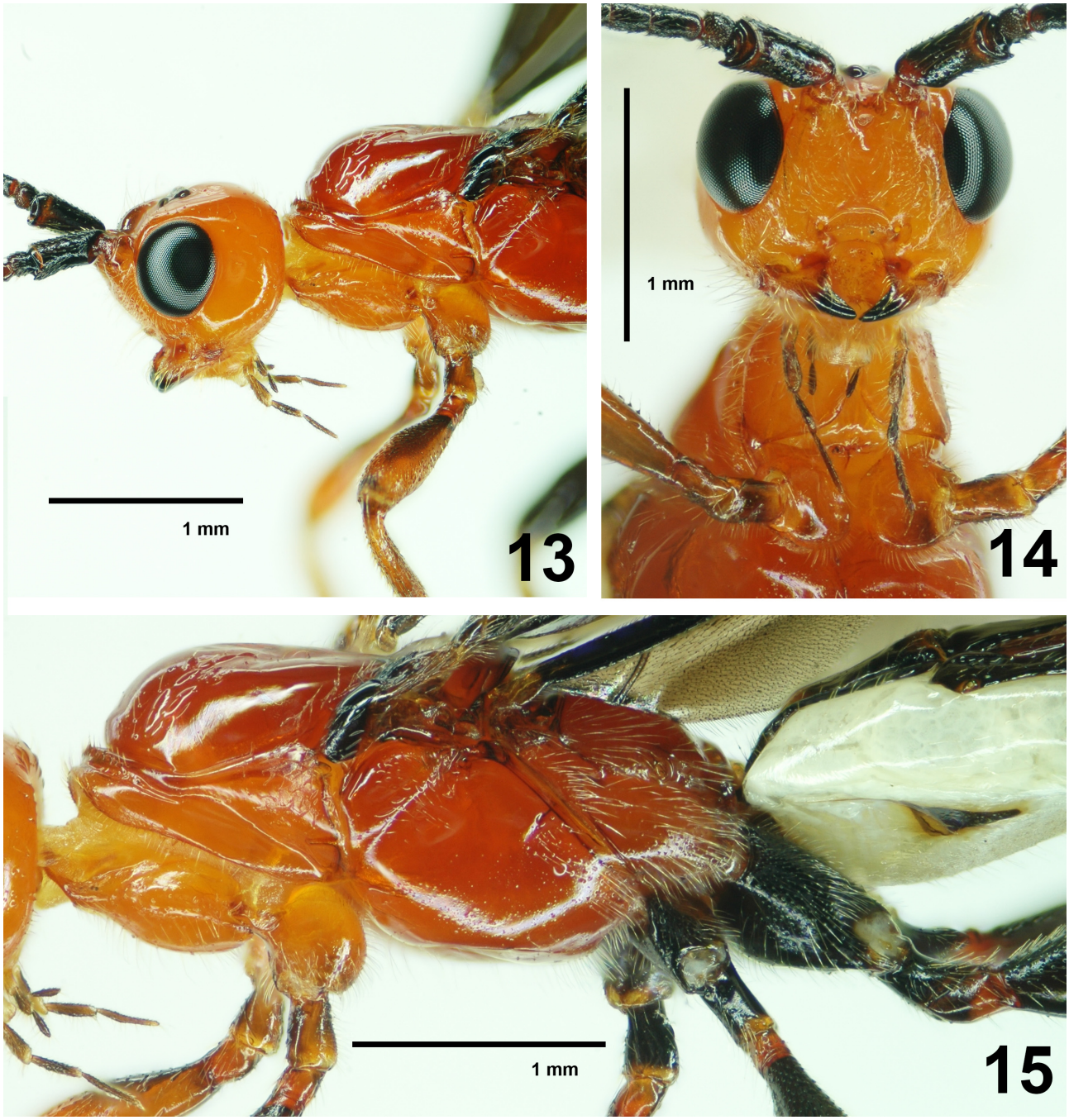
Female. Body length 7.5–10.1 mm, fore wing length 6.3–8.5 mm.



FIGURES 5–9. *Atanycolus yangi* sp. nov. adult female on trunk of *P. persica*. 5, Female resting on trunk of *P. persica*. 6, Female drilling into trunk of *P. persica* with ovipositor. 7, Male resting on trunk of *P. persica*. 8–9, Female drilling into log under laboratory rearing conditions.

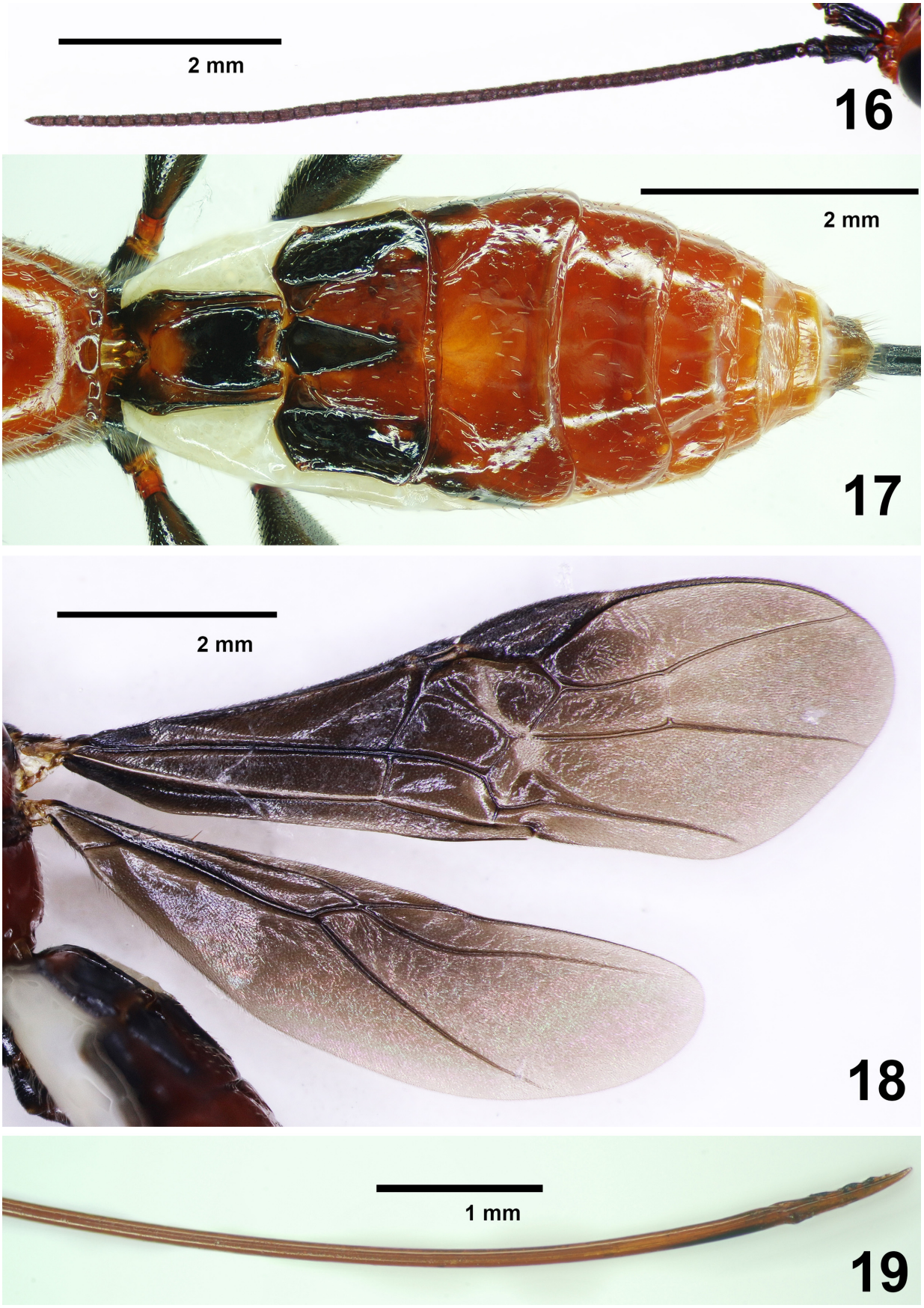


FIGURES 10–12. Female of *Atanycolus yangi* sp. nov. 10, Habitus in dorsal view. 11, Head and mesosoma in dorsal view. 12, Habitus in lateral view.



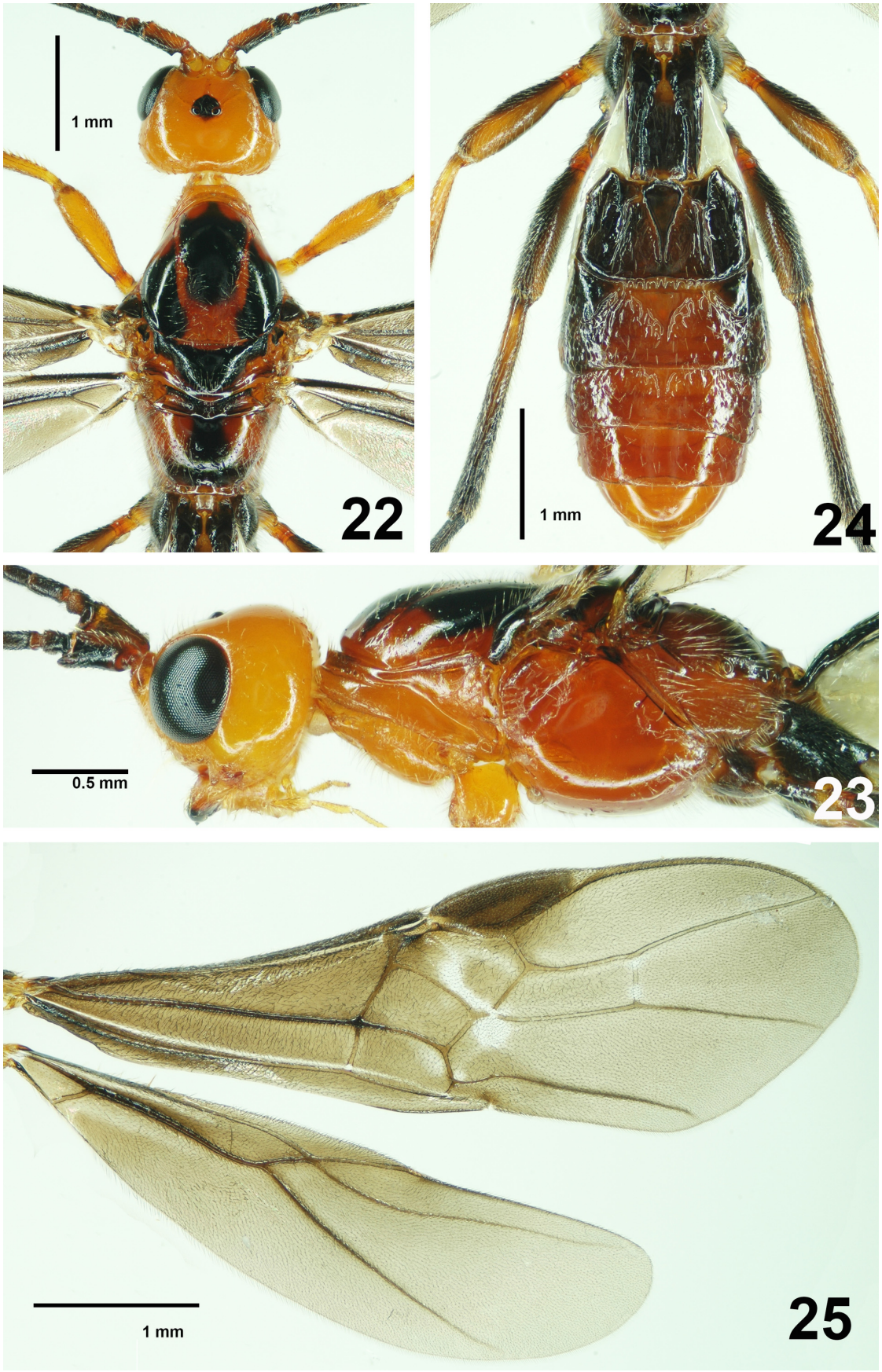
FIGURES 13–15. Female of *Atanycolus yangi* sp. nov. 13, Head in lateral view. 14, Head in anterior view. 15, Mesosoma in lateral view.

Color (Figs 10–19). Body generally reddish orange. Head shining orange, antenna, eyes, ocelli, apical mandible black, maxillary palpus and labial palpus brown. Mesosoma reddish orange with propleuron slightly lighter, tegula and axilla black. Wings blackish, apical half infuscate. Fore leg generally orange, fore tarsus, trochanter and femur dorsally brown; middle leg generally black, trochantellus and mid tibia 1/8 apically 1/7 basally orange, mid tarsus darkish brown; hind leg black. Epipleuron of first metasomal tergite and sternum white, median rectangular area black; second metasomal tergite orange, with marginal parts and sternum white, triangular medio-basal area and antero-lateral areas of second tergite black; third metasomal tergite orange with antero-lateral triangular areas black; ovipositor sheath dark brown.



FIGURES 16–19. Female of *Atanycolus yangi* sp. nov. 16, Antenna in lateral view. 17, Metasoma in dorsal view. 18, Wings. 19, Ovipositor tip in lateral view.

FIGURES 20–21. Male of *Atanycolus yangi* sp. nov. 20, Habitus in dorsal view. 21, Habitus in lateral view.



FIGURES 22–25. Male of *Atanycolus yangi* sp. nov. 22, Head and mesosoma in dorsal view. 23, Head and mesosoma in lateral view. 24, Metasoma in dorsal view. 25, Wings.

Head (Figs 11, 13–14). In dorsal view, head width 1.3 × median length, vertex smooth and shining, with sparse long setae; median length of vertex 2.3 × median length of frons; ocellar triangle regular triangular, convex, OOL: OD: POL = 10: 2: 3; length of eye: length of temple = 1. In anterior view, width of head median 1.2 × height of head; minimum distance between eyes 1.3 × height of eye; face smooth, covered with more setae than frons and vertex; height of clypeus 0.26 × its width; mandible robust and obtuse triangular; width of malar space 0.45 × height of eye. In lateral view, maximum height of head (including mandible) 1.1 × maximum length of head. Antenna with 52 antennomeres, scape 1.6 × its maximum width and 2.0 × length of 1st flagellomere; 1st flagellomere 1.2 × its maximum width, 1.4 × 2nd flagellomere; last flagellomere acute apically

Mesosoma (Figs 11, 15). In dorsal view, mesosoma smooth with sparse setae; median length of mesoscutum 0.96 × its width; middle lobe of mesoscutum evenly rounded anteriorly and quadrate posteriorly; notauli weak, parallel; scutellar sulcus 0.44 × maximum width of mesoscutum and 1.3 × median length of scutellum, with weak carinae; scutellum smooth with sparse long setae, length 0.5 × basal width; metanotum 0.37 × median length of scutellum, median area convex transversely, with two longitudinal carinae sub-bilaterally; propodeum smooth with long white setae evenly. In lateral view, length of mesosoma 2.3 × its height; mesoscutum rapidly elevated above pronotum; mesopleuron smooth with sparse long setae; metapleuron with long dense white setae.

Wings (Fig. 18). Length of fore wing 3.0 × its maximum width; pterostigma 2.9 × as long as its maximum width; vein 1-R1 1.7 × length of pterostigma; vein r originates at median pterostigma; vein SR1 1.8 × vein 3-SR; vein 3-SR 3.0 × vein r; vein r 0.6 × vein 2-SR; meeting point of veins 2-SR, 2-M and 2-SR+M less sclerotized, veins interrupted; vein 1-SR+M curved slightly; vein 1-SR 0.4 × length of vein 1-M; vein r-m interrupted both ends, straight; veins 3-M and CU1a extending to wing margin. Length of hind wing 3.9 × its maximum width; vein M+CU 0.38 × length of vein 1-M; 1-SR curved, extending to anterior margin; vein 2-M developed.

Legs (Fig. 12). Fore femur 0.9 × as long as fore tibia and 4.0 × as long as its width, fore tibia 8.0 × its width, spur 0.43 × as long as basitarsus of fore leg, ratio of fore tarsomeres I–V = 35: 30: 22: 11: 13; middle femur 0.78 × middle tibia, spur 0.33 × as long as basitarsus of middle leg, ratio of middle tarsomeres I–V = 30: 20: 15: 8: 15; hind femur 3.3 × its width, 0.7 × as long as hind tibia, ratio of hind tarsomeres I–V = 35: 23: 15: 6: 19.

Metasoma (Figs 15, 17). Oblong; first tergite 0.7 × its maximum apical width in dorsal view (excluding epipleuron); epipleuron developed and triangular, 2.5 × its maximum width; first tergite with median shaded area shinning and smooth, lateral grooves weak and median large area convex, medio-longitudinal carina absent. Second tergite with triangular convex medio-basal area narrow and slender, baso-lateral areas convex, shining and smooth. Suture between 2nd and 3rd tergites 1.3 × median length of 3rd tergite, baso-lateral areas of third tergite convex. 4th–7th tergites smooth and shining, with spare setae. Length of ovipositor sheath 1.45 × as long as median length of metasoma, 1.1 × as long as length of fore wing. Ovipositor with minute six teeth ventro-apically, ovipositor with a dorsal nodus.

Male (Figs 20–25). Body length 5.8–6.7 mm, fore wing length 4.6–5.5 mm.

Head with basal scape orange dorsally. Mesoscutum black, with notauli and medio-posterior area orange, scutellum black; median metanotum and propodeum black; mid leg generally orange, tarsus, trochanter and femur dorsally brown; basal 1/3 of hind tibia orange; second metasomal tergite dark brown to black, third metasomal tergite black bilaterally.

Epipleuron of first metasomal tergite slender, lateral grooves relatively wide and sparsely crenulate; triangular medio-basal area of second tergite with two oblique long and sparsely crenulate grooves laterally. Suture between 2nd and 3rd tergites shorter and wider, with 7–8 crenulations. 3rd and 4th tergites with triangular medio-basal areas.

Otherwise, similar to female.

Distribution. China (Beijing).

Host confirmation. *Lamprodila nobilissima bellula* (new and first host record). The type specimens of *A. yangi* sp. nov. were not reared directly from a host, but collected from an infested tree trunk. Only two species of woodborers were found infesting the surveyed trees, *A. bungii* and *L. nobilissima bellula.* The larvae of *A. bungii* (i.e., roundheaded borer) and *L. nobilissima bellula* (i.e., flatheaded borer) are easily distinguished. Because of their concealment under the bark or wood, there are two methods to determine the host-parasitoid association: 1) dissecting tree trunks in the field to collect parasitized hosts directly, and 2) rearing parasitoids on host-infested logs in the laboratory. During the dissections, all *A. bungii* were found alive in the phloem and xylem of the trunks, while some *L. nobilissima bellula* were found paralyzed in the phloem but still remained fresh, indicating they were newly parasitized and injected with parasitoid venom. During the laboratory rearing, small peach logs were infested

by either *A. bungii* or *L. nobilissima bellula* larvae and exposed to *A. yangi* sp. nov females. The female wasps only drilled into logs that were infested with *L. nobilissima bellula* larvae (Figs 8, 9), and parasitoid offspring developed successfully to adults from parasitized *L. nobilissima bellula* larvae. The offspring sex ratio (female to male) was 1.25 based on the type materials. Afterward, dissections confirmed that *A. yangi* sp. nov. is a solitary ectoparasitic larval parasitoid of *L. nobilissima bellula*. The author Zhong-Qi Yang also stated that he has collected many adults of this species from Fenghuang Montane in Beijing, but there was no flatheaded borer in that tree, only larvae of *A. bungii* were present, we still cannot confirm *A. bungii* was not its host.

Etymology. The new species name is derived from the last name of Prof. Zhong-qi Yang, in memory of his 40 years' work on parasitoid taxonomy and biological control of forest insect pests.

Remarks. The new species resembles several Oriental and Palaearctic species in this genus, which can be separated with the key as described below. All these species have the same characteristics of females having second metasomal tergite smooth, not sculptured, third metasomal tergite smooth, with antero-lateral triangular areas undeveloped (Fig. 17).

Key to Oriental and Palaearctic species similar to *A. yangi* sp. nov. in the genus *Atanycolus*

1	Female mesosoma totally black, male mesosoma black	2
-	Female mesosoma totally yellow to orange, male mesosoma most (Fig. 22) or totally black (see Ahmed et al. 2022: Fig. 1b)	6
2	Head red, only ocelli black (see Telenga 1936: key, redescription)	*A. fulviceps* (Kriechbaumer)
-	Head totally black, or yellow to red with frons or ocellar large field black	3
3	Head black, except for eye orbits yellowish red.	*A. denigrator* (Linnaeus)
-	Head yellow to red, sometimes with stemmaticum and frons black widely or narrowly	4
4	Metasoma usually totally yellow, sometimes first metasomal tergite brown (see Li et al. 2020: Fig. 8e)	*A. initiator* (Fabricius)
-	Metasoma with first tergite black (see Li et al. 2020: Figs 12j, 18j); Triangular medio-basal area and antero-lateral areas of second tergite brown, other tergites yellow	5
5	Head with stemmaticum and frons black, black area not extending backwards; temples weakly expanded behind eyes (see Li et al. 2020: key)	*A. setosus* Li, He & Chen
-	Head dorsally with a moderately large black and reverse guttiform spot around stemmaticum; temples strongly expanded behind eyes (see Li et al. 2020: key)	*A. lindemani* Tobias
6	Female body length 13 mm, epipleuron of first metasomal tergite and sternum yellow, second metasomal tergite totally orange (see Ahmed et al. 2022: Figs 2g, 2h)	*A. tangmargensis* Ahmed, I. & Kazmi
-	Female body length 7.5–10 mm, epipleuron of first metasomal tergite and sternum white, second metasomal tergite with marginal parts and sternum white, triangular medio-basal area and antero-lateral areas of second tergite black (Figs 17, 24)	*A. yangi* Cao, Xie et Wang, sp. nov.

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