



Two new species of *Trichrysis* Lichtenstein (Hymenoptera: Chrysididae) from Vietnam and China, with taxonomic notes on other species from the Oriental region

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Abstract

Two new species of the genus *Trichrysis* Lichtenstein, belonging to the *cyanea* species group, are described from northeastern Vietnam (Cao Bang Province) and China (Yunnan Province) as new for science: *T. sinica* Rosa, Nguyen & Wiśniowski, **sp. nov.**, and *T. striata* Nguyen, Wiśniowski & Rosa, **sp. nov.** The redescription of *T. tonkinensis* (Mocsáry, 1914) and additional descriptive characters for *T. chamchuensis* Wiśniowski & Nguyen, 2020 are provided.

Key words: Chrysidini, *cyanea* species-group, new species, Oriental region, Vietnam

Introduction

After the revision of the Chinese *Trichrysis* Lichtenstein, 1876 (Rosa *et al.* 2016), new material became available and new studies on the Oriental fauna including members of the genus *Trichrysis* were published (Wiśniowski *et al.* 2020; Rosa *et al.* 2021, 2022). The increase in available material has contributed to a better understanding of the faunal composition of the Oriental region, despite the fact that we still have only scattered data from most of the countries and, therefore, other discoveries are expected.

Recently, four species of the *cyanea* species group of the genus *Trichrysis* were described from Vietnam (Wiśniowski *et al.* 2020). The description of one of these species, namely *T. chamchuensis* Wiśniowski & Nguyen in Wiśniowski *et al.* (2020) was based on two female specimens missing the sterna. Their morphological description was therefore incomplete because the shape of the black spots on the second sternum is considered an important diagnostic character. An additional specimen of *T. chamchuensis* was found during a recent collection trip in northern Vietnam, which now allows us to complete the description of the black spots on the second sternum.

The new field collections carried out in 2021 and 2022 in the northern regions of Vietnam resulted in quite a rich sample of specimens representing the genus *Trichrysis*. A detailed study of the collected specimens revealed another undescribed species of the *cyanea* species group and gave us the opportunity to study additional specimens of a species already recorded for the country, *T. tonkinensis* (Mocsáry, 1914). In particular, examination of these specimens allows us to reevaluate another species collected in China, illustrated in Rosa *et al.* (2016) and previously identified as *T. tonkinensis*. This Chinese species is described here as new for science with the name *T. sinica* Rosa, Nguyen & Wiśniowski, **sp. nov.**

The goal of this paper is to describe and illustrate two new species for science and provide a better overview of the Oriental members of the genus *Trichrysis* in the *cyanea* species group.

Materials and methods

The Vietnamese specimens are deposited at the Institute of Ecology and Biological Resources (IEBR) in Hanoi and were examined and described with a Nikon SMZ 800N stereomicroscope. Stack microphotographs were taken with the Sony Alpha 5000 camera attached to a Nikon SMZ800N stereomicroscope (manually operated). The images were captured with the following software: Remote, ver. 1.4.00.01241, Copyright 2017-2019 Sony Imaging Products & Solutions, Inc. Microphotographs were stacked with Helicon Focus 6 software. The resulting images were finally edited with Adobe CC software: Adobe Photoshop 2020 and Adobe InDesign 2020. *Trichrysis sinica* was examined and described with a stereomicroscope (Leica MZ125) and photographs of the type of *Trichrysis tonkinensis* were taken with a Nikon D-80 digital camera connected to stereomicroscope Togonal SCZ and stacked with software Combine ZP software.

Morphological features are named mostly after Kimsey & Bohart (1991), while some terms are used after Lanes *et al.* (2020), such as metapectal-propodeal disc. The body length of the specimens was measured on microscope images from the frons on the head to the apex of the metasoma. The abbreviations in the text should be understood as follows (compare Bohart 1988 and Rosa *et al.* 2016, with minor changes): **BOL** = brow-ocellar line, the shortest distance between the median ocellus and the transverse frontal carina; **F1**, **F2**, ... = the first flagellomere, the second flagellomere, etc.; **l/w** = length/width ratio; **MOD** = median ocellus diameter (measured in frontal view); **MS** = malar space, the shortest distance between the base of the mandible and the lowest margin of the compound eye; **OOL** = oculo-ocellar line, the shortest distance between the posterior ocellus and the compound eye; **P** = pedicel; **PD** = puncture diameter; **POL** = posterior ocellar line, the shortest distance between posterior ocelli; **S2** = the second metasomal (gastral) sternum; **S2 spots** = two symmetrical black spots on S2, usually fused in *Trichrysis* along the middle line; **T1**, **T2**, **T3** = the first, the second, the third metasomal tergum; **TFC** = transverse frontal carina.

The label data are cited exactly as on the original labels. Type specimens are housed in the collections of the Institute of Ecology and Biological Resources (Hanoi, Vietnam) and the Natur-Museum (Luzern, Switzerland).

Other abbreviations used in the text are as follows:

IEBR	Institute of Ecology and Biological Resources, Hanoi, Vietnam
HNHM	Magyar Természettudományi Múzeum, Budapest, Hungary
NMLU	Natur-Museum, Luzern, Switzerland
NP	National Park
NR	National Reserve
NQC	Nguyen Quang Cuong (collector)
NTPL	Nguyen Thi Phuong Lien (collector)
RS	Ranger Station
TTN	Tran Thi Ngat (collector)
/	marks the lines of text on original labels

Taxonomic account

Trichrysis chamchuensis Wiśniowski & Nguyen in Wiśniowski *et al.*, 2020
(Fig. 1)

Material examined. 1♀, VIETNAM; Cao Bang, Nguyen Binh, Quang Thanh / Hoai Khao, Phia Oac-Phia Den NP / 879 m a.s.l.; 10.v.2021 / 22°36'39"N 105°54'40"E / [leg.] NTPL, NQC, TTN (IEBR).

Remarks. In our previous article, *Trichrysis chamchuensis* was described based on type specimens from Cham Chu NR, Ham Yen, Tuyen Quang, Vietnam, but mentioned that '*all sterna in both the holotype and paratype are*

partly destroyed ventrally, and therefore black spots cannot be described' (Wiśniowski *et al.* 2020). During the present study, an intact female of this species was collected and their black spots on S2 were studied: they are almost triangle-shaped and fused medially (Fig. 1).



FIGURE 1. *Trichrysis chamchuensis* Wiśniowski & Nguyen, 2020 (female). S2, ventral view. Scale bar = 0.5 mm.

***Trichrysis sinica* Rosa, Nguyen & Wiśniowski, sp. nov.**

(Figs 2–7)

urn:lsid:zoobank.org:act:3F7C60AA-D301-485F-816B-B5BB52816566

Material examined. Holotype, 1♀, CHINA; / S China—10.–14.7.1990 / Jinghong pr. YUNNAN / lgt. S. Bečvář (NMLU).

Diagnosis. Middle-sized species with robust, densely punctate body and golden-green colouration with olive-green to brown colour on interstices of vertex and mesosoma (Fig. 2); scape and pedicel fully metallic green; tegula brown with indistinguishable metallic reflection. TFC weak, slightly raised and angled medially. Sublateral carina fully developed. T2 with weak median carina. Median tooth on apex of T3 sharp and pointed (Fig. 6). S2 black spots ogival, fused medially, longer than wider (Fig. 7).

Description. Female. Holotype, body length 5.2 mm.

Head. Scapal basin deep, punctate laterally and striate medially (Fig. 3). TFC single, short, slightly inverted V-shaped. Area between TFC and scapal basin slightly raised. Relative length of P:F1:F2:F3=1.0:1.6:0.7:0.6; F1 l/w=2.9; OOL=2.0 MOD; BOL=1.7 MOD; POL=1.8 MOD; MS=1.0 MOD; clypeal apex slightly concave.

Mesosoma. Median pronotal line deep, extending to 3/4 length of pronotum; sublateral carina distinct and complete (Figs 2, 4), lateral margin of pronotum concave medially. Mesoscutellum antero-medially with wide interstices; punctuation contiguous on metanotum, with punctures larger than on mesonotum. Episternal sulcus and scrobal sulcus with large areolate punctures (Fig. 4).

Metasoma. Punctures on T2 geminate, interstices punctate (Fig. 5); punctuation decreasing in diameter toward posterior margin on T2. T2 and T3 with weak median carina. T3 prepit bulged medially convex; pit row with small and round separated pits. Apex of T3 with three pointed teeth similar in size, with interval between median tooth and lateral tooth straight (Figs 5, 6). S2 black spots ogival and medially fused (Fig. 7).

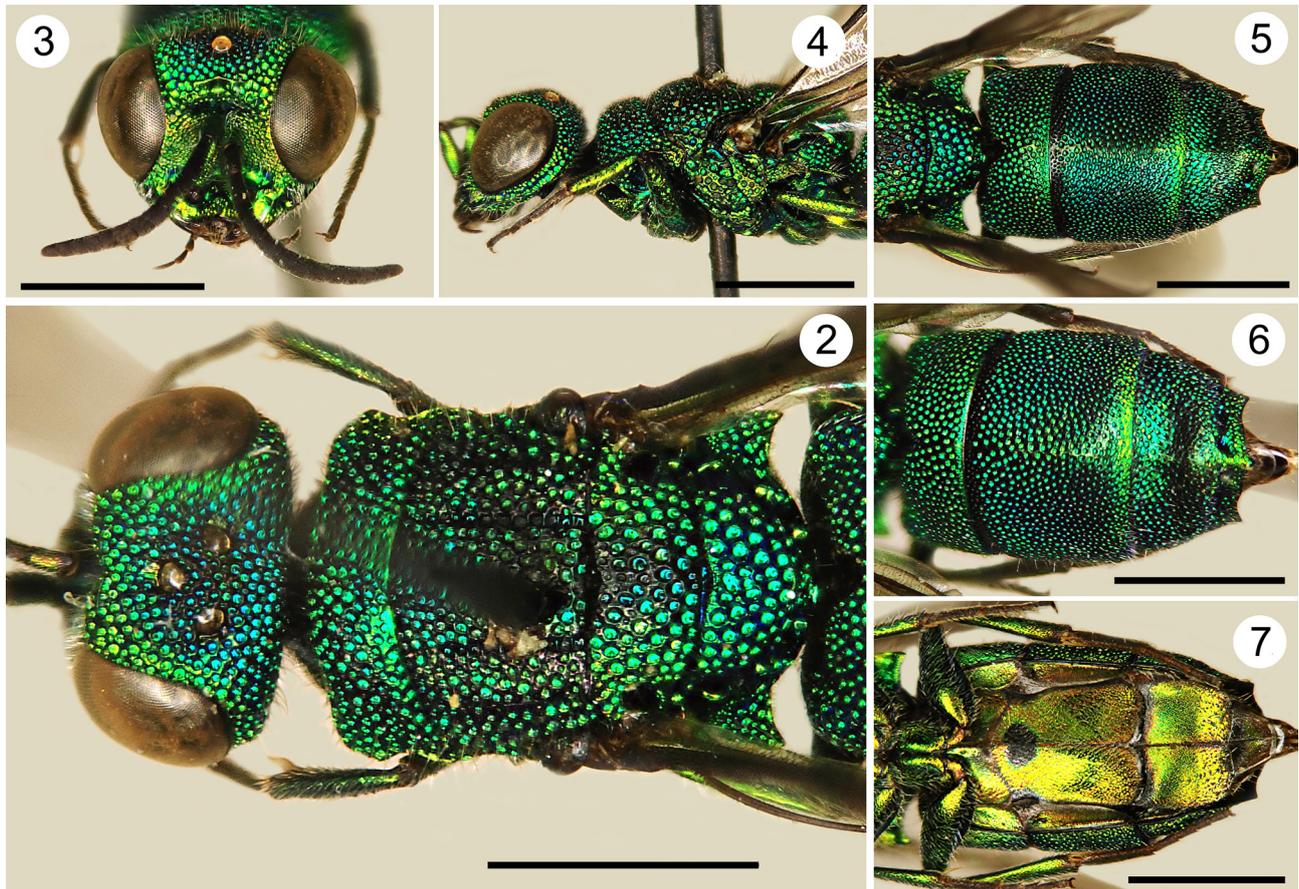
Colouration. Body metallic green with olive colour on interstices of the punctuation of the fore body, with golden reflection on face and sternites. Scape and pedicel metallic green, flagellum black. Tegula brown, with weak metallic reflections. Legs metallic green, with tarsi black. Wings slightly infusate.

Male. Unknown.

Distribution. China (Yunnan).

Remarks. After examination of more material, we can state that the Chinese specimen photographed and identified by Rosa *et al.* (2016) as *Trichrysis tonkinensis* actually belongs to an undescribed species. At that time, we examined several specimens preserved in the Linsenmaier collection (NMLU) from China, India, Indonesia and Malaysia and identified by the Swiss author as *T. tonkinensis*. They all showed a certain variability, which was difficult to evaluate in a few specimens collected in such a wide area. Therefore, we considered all these specimens to belong to the same taxon, with regional variability. At least the Chinese species photographed by Rosa *et al.* (2016) can be now considered separated from the Vietnamese *T. tonkinensis*. We include in the type series only the specimen photographed in Rosa *et al.* (2016) from Rosa's collection, that will be deposited in NMLU. Specimens listed in Rosa *et al.* (2016) from other Oriental localities must be re-evaluated in the light of recent studies (Rosa *et al.* 2021, 2022; Wiśniowski *et al.* 2020).

Trichrysis sinica **sp. nov.** is very similar to *T. excisifrons* for the habitus and ogival shape of the black spots on S2 (see pictures of the type in Rosa *et al.* 2021); it is separated by the weak TFC, slightly arched (vs. raised and inverted V-shaped in *T. excisifrons*); brown tegulae, with a weak green reflection (vs. fully metallic blue); body colour green based (vs. blue); the colour of tegulae is often considered as a diagnostic feature in some Chrysidini genera (Linsenmaier 1959; Rosa *et al.* 2016). *Trichrysis sinica* is similar to *T. tonkinensis* and *T. striata* Nguyen & Wiśniowski, **sp. nov.** for habitus and colour, but is separated by the weak, medially acute TFC (vs. raised, straight, and only medially slightly angled, with endings laterally bent under and close to eye margin); ogival shape of the black spots on S2 (vs. triangular, wider than long); T3 sparsely punctate before prepit bulge (vs. densely punctate).



FIGURES 2–7. *Trichrysis sinica* **sp. nov.**, holotype (female). 2. Head and mesosoma, dorsal view. 3. Head, frontal view. 4. Head and mesosoma, lateral view. 5. Propodeum and metasoma, dorsal view. 6. Metasoma, posterior view. 7. Metasoma, ventral view. Scale bar = 1 mm.

***Trichrysis striata* Nguyen, Wiśniowski & Rosa, sp. nov.**

(Figs 8–15)

urn:lsid:zoobank.org:act:AFF70930-25BA-4CDF-AF22-1345E96EC3D3

Material examined. Holotype, ♀: VIETNAM; Cao Bang, Nguyen Binh, Quang Thanh / Hoai Khao, Phia Oac-Phia Den NP / 579 m; 10.v.2021 / 22°36'39"N 105°54'40"E / [leg.] NTPL, NQC, TTN (IEBR).

Diagnosis. Middle-sized species with robust, densely punctate body and mostly golden-green colouration with some blue colour dorsally (Fig. 8). Brow prominent, TFC single, slightly convex, only laterally with traces of second carina. Area below TFC with elongate, weakly defined punctures. Scapal basin deep and punctate, punctures partially fused medially, forming transverse striae, and with large oval facial pit. Dorsal part of pedicel metallic copper. Sublateral pronotal carina fully developed (Figs 8, 12). T1 and T2 bright green and blue dorsally, golden green laterally, and apically. T2 with distinct median carina, present throughout it (Fig. 14). Median tooth on apex of T3 sharp and pointed (Figs 14, 15), interval between median tooth and lateral tooth slightly wavy curved, pits distinct, of same size. S2 black spots triangular, fused medially, forming black mark twice wider than its length (Fig. 13).

Description. *Female.* Holotype, body length 7.0 mm.

Head. Scapal basin deep and punctate; small, median punctures partially fused forming transverse striae, and with distinct oval facial pit (Fig. 9). Brow prominent, TFC single, slightly convex, with traces of second carina. Brow raised between TFC and scapal basin. Brow above TFC flattened, with dense punctures. BOL $1.4 \times \text{MOD}$. Relative length of P:F1:F2:F3=1.2:2.2:1.3:1.0; F1 $1/w=2.9$; OOL $2.1 \times \text{MOD}$; POL $2.0 \times \text{MOD}$; MS $1.1 \times \text{MOD}$; clypeal apex arcuate medially. Mandible simple, without subapical tooth. Malar space with dense medium-sized punctures, and with genal carina reaching up to $2/3$ of head height. Setae on vertex whitish, some of them longer than $1 \times \text{MOD}$. Ocellar triangle obtuse (Fig. 10).

Mesosoma. Median pronotal line moderately deep, not extending to posterior margin of pronotum. Sublateral, longitudinal carina on pronotum fully developed (Figs 8, 12). Punctuation on pronotum, mesoscutum and mesoscutellum with variable interstices, $0.2\text{--}0.5 \times \text{PD}$; interstices shining and punctate (Fig. 11). Mesepisternum with large punctures, interstices narrow, $0.1\text{--}0.5 \times \text{PD}$. Episternal sulcus and especially scrobal sulcus with large areolate punctures, about $2.0 \times$ as large as punctures on mesepisternum (Fig. 8). Setae on outer edge of metatibia short, not longer than half their distal width.

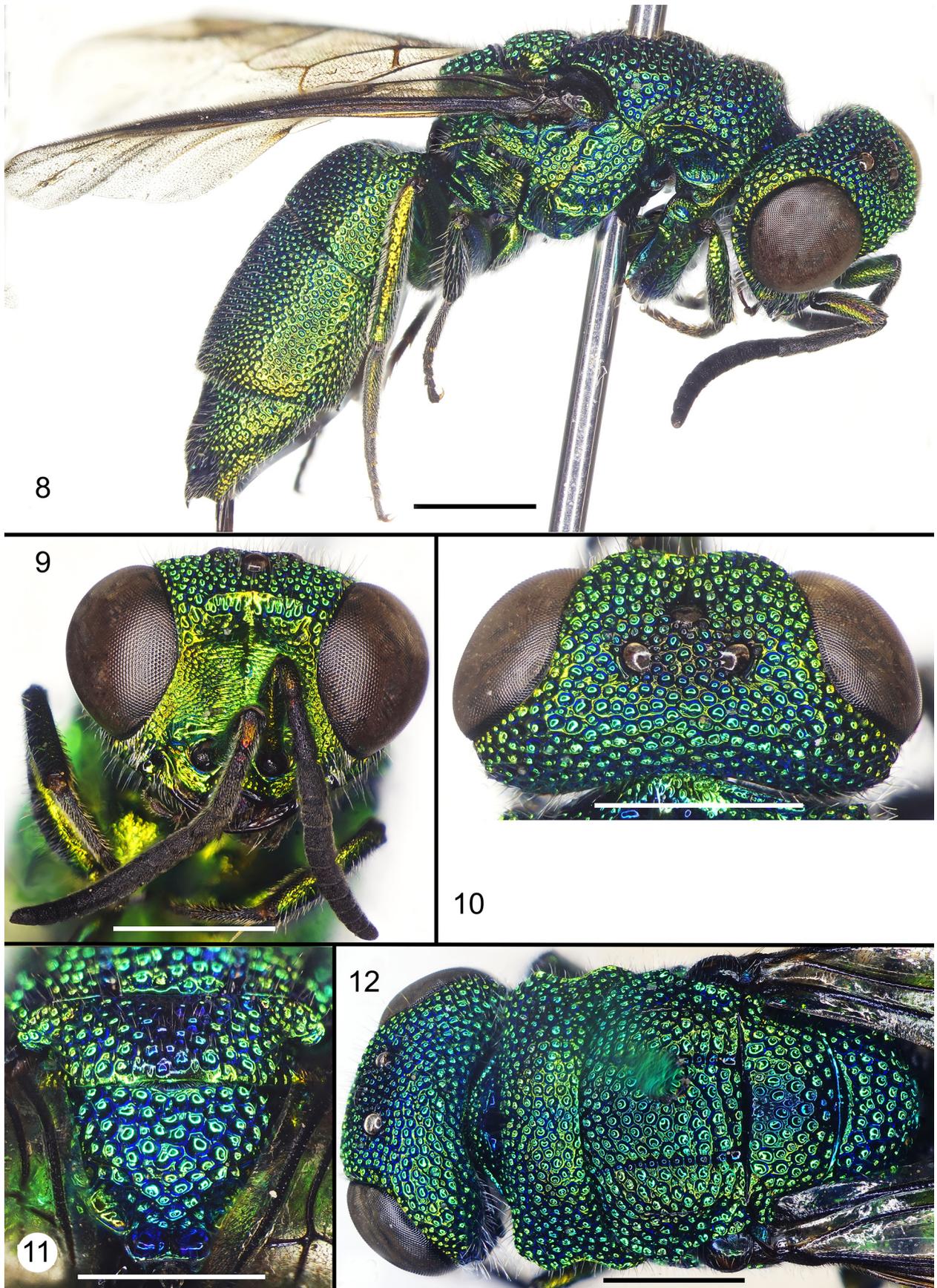
Metasoma. Metasoma densely punctate; punctures smaller than on mesosoma. Interstices on T1 and T2 $0.2\text{--}1.0 \times \text{PD}$, polished, almost smooth, with scattered tiny punctures. T1 with short median groove anteriorly, T2 with distinct median carina, reaching posterior margin (Fig. 14). T3 punctate and medially wrinkled (Fig. 14); prepit bulge slightly convex (Fig. 15); pits large, apical rim wrinkled (Fig. 14). Median tooth on apex of T3 sharp and pointed, lateral teeth shorter (Fig. 14). Interval between median tooth and lateral tooth slightly wavy curved. S2 black spots triangular, fused medially, forming black mark twice wider than its length (Fig. 13).

Colouration. Body metallic golden green, with blue reflections on pronotum, mesoscutum, mesoscutellum, metanotum and laterally on mesosoma. Terga golden green. Median blue spot on mesoscutellum large. Ocellar triangle with dark brownish interstices. Scape metallic green, dorsal part of pedicel metallic copper, rest of flagellum black. Tegula predominantly metallic blue, outer margin partly brownish-black. Wings slightly dimmed. Legs metallic bright green, basitarsi greenish, rest of tarsi blackish.

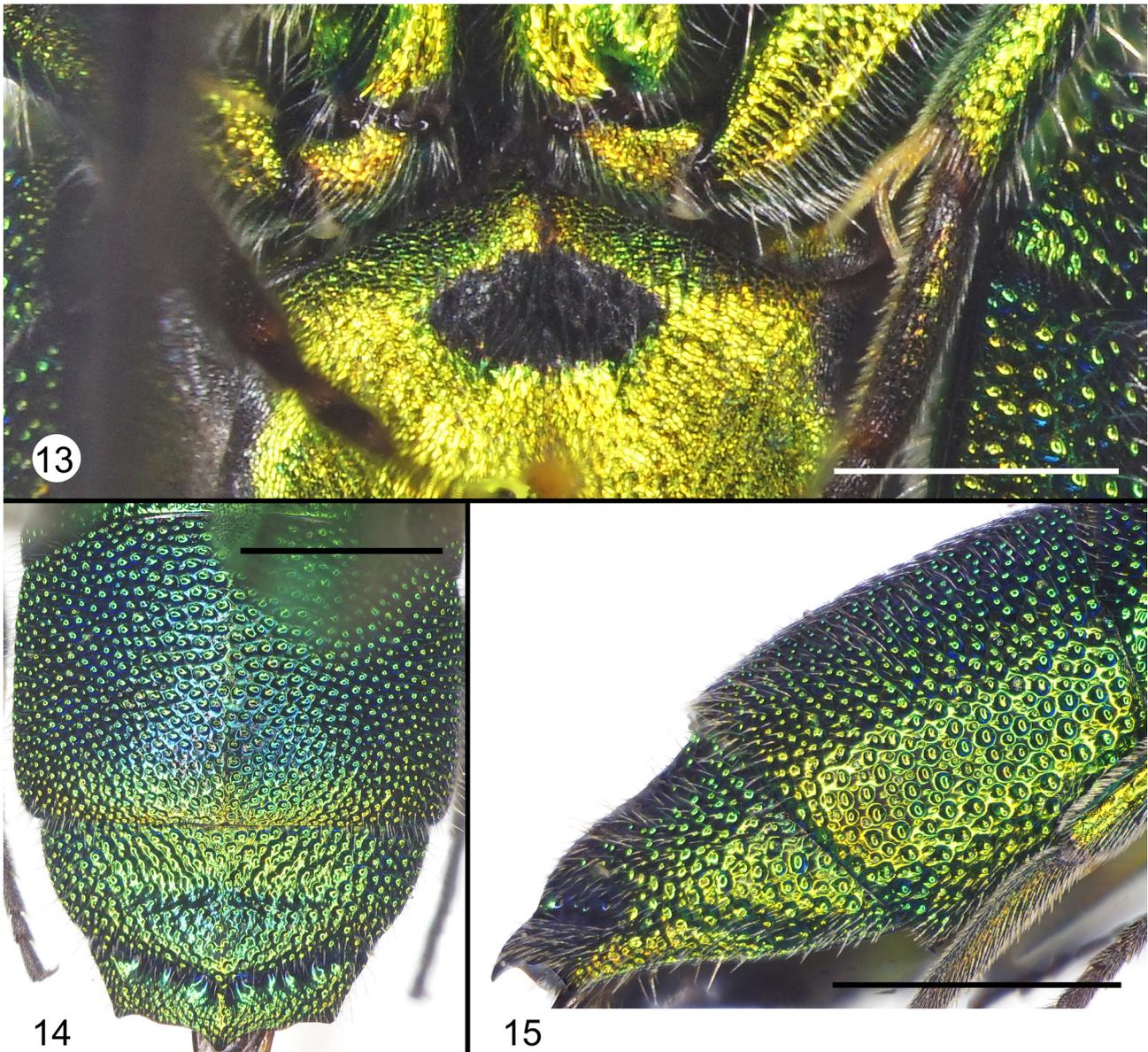
Male. Unknown.

Distribution. North-eastern Vietnam, Cao Bang Province.

Remarks. *Trichrysis striata* sp. nov. is similar to *T. tonkinensis* but it is differentiated by the following characters: large blue spot medially on mesoscutellum (vs. small spot medially on mesoscutum, not on mesoscutellum in *T. tonkinensis*); interval between median and lateral tooth slightly wavy (vs. fully incurved); S2 black spots triangular, fused medially (vs. versus S2 black spots almost trapezoid, fused medially in *T. tonkinensis*).



FIGURES 8–12. *Trichrysis striata* sp. nov., holotype (female). 8. Habitus, lateral view. 9. Head, frontal view. 10. Head, dorsal view. 11. Mesoscutellum, metanotum and metapectal-propodeal disc, posterior view. 12. Head and mesosoma, dorsal view. Scale bar = 1 mm.



FIGURES 13–15. *Trichrysis striata* sp. nov., holotype (female)—*continued*. 13. S2, ventral view. 14. T2 and T3, dorsal view. 15. T2 and T3, lateral view. Scale bar = 0.5 mm (Fig. 13); 1 mm (Figs 14, 15).

***Trichrysis tonkinensis* (Mocsáry, 1914)**

(Figs 16–28)

Chrysis (*Trichrysis*) *tonkinensis* Mocsáry, 1914: 25. Holotype, ♀ [not ♂], Vietnam: Tonkin (HNHM) (examined).

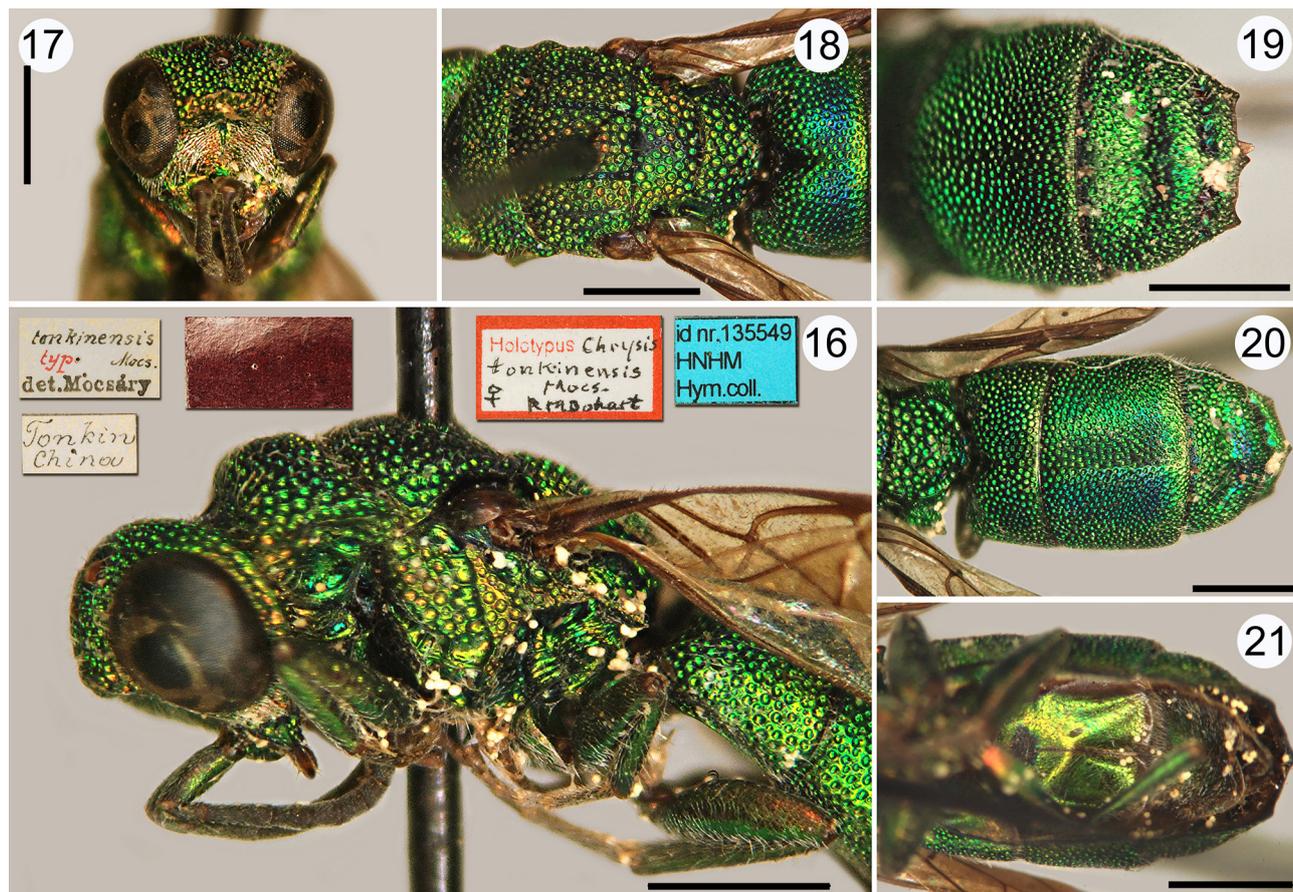
Material examined. 1 ♀: VIETNAM: Tonkin China / *tonkinensis* Mocs. det. Mocsáry typ. <handwritten in red> / red label / Holotypus *Chrysis tonkinensis* Mocs. ♀ RM Bohart / id. nr. 135549 HNHM Hym.coll. (HNHM). 2 ♀: VIETNAM; Cao Bang, Nguyen Binh, Quang Thanh / Hoai Khao, Phia Oac-Phia Den NP / 879 m a.s.l.; 10.v.2021 / 22°36'39"N 105°54'40"E / [leg.] NTPL, NQC, TTN (IEBR). 3 ♀: VIETNAM; Ha Tinh, Vu Quang / Vu Quang NP, Khe Che RS / 18°24'33"N 105°18'39"E, 32 m a.s.l. / 20.iv.2022, NTPL, TTN.

Diagnosis. Middle-sized species with robust, densely punctate body; colouration mostly golden-green with some olive-green colour on interstices of vertex and mesosoma and blue colour dorsally (Figs 18, 20, 25, 27). Ocellar triangle with dark brownish interstices; dorsal part of pedicel metallic copper. Sublateral, longitudinal carina in pronotum fully developed (Figs 16, 18, 23, 25). TFC raised, straight, medially as an acute angle, laterally bent

close to eye margin (Figs 17, 22). Tegula brown to predominantly metallic green; outer margin partly brownish-black. T1 and T2 bright blue dorsally, golden-green laterally and apically. T2 with weak median carina, almost reaching posterior margin (Figs 20, 26). Median tooth on apex of T3 sharp and pointed (Figs 19, 26). S2 black spots trapezoid, fused medially, forming black mark wider than its length (Fig. 28).

Redescription. *Female* (Figs 16–28). Body length 6.5–7.0 mm.

Head. Scapal basin deep and punctate, medially with punctures partly fused forming transverse striae (Figs 17, 23). Brow prominent, TFC single, medially slightly inverted V-shaped, recurved laterally. Brow raised between TFC and scapal basin, polished medially, with elongated shallow punctures. Surface of brow above TFC flattened, with dense punctures. BOL $1.5 \times$ MOD. Relative length of P:F1:F2:F3=1.0:2.0:1.2:1.0; F1 l/w=2.6; OOL $1.9 \times$ MOD; POL $2.0 \times$ MOD; MS = MOD; clypeal apex arcuate medially. Mandible simple, without subapical tooth. Malar space with few medium punctures, and with genal carina reaching up to 2/3 of head height. Setae on vertex whitish, not longer than MOD. Ocellar triangle obtuse (Fig. 24).



FIGURES 16–21. *Trichrysis tonkinensis* (Mocsary, 1914), holotype, ♀. 16. Head, mesosoma and T1, lateral view. 17. Head, frontal view. 18. Mesosoma and T1, dorsal view. 19. T2 and T3, posterior view. 20. Metasoma, dorsal view. 21. Metasoma, ventral view. Scale bar = 1 mm.

Mesosoma. Median pronotal line moderately deep, not extending to posterior margin of pronotum. Sublateral carina on pronotum fully developed (Figs 16, 18, 23, 25). Punctuation on pronotum, mesoscutum and mesoscutellum with variable interstices, $0.2\text{--}0.8 \times$ PD; interstices shining and micropunctate. Mesepisternum with large punctures, interstices narrow, $0.1\text{--}0.5 \times$ PD. Episternal sulcus and scrobal sulcus with large areolate punctures, about $1.8 \times$ as large as punctures on mesepisternum (Fig. 16). Setae on outer edge of metatibia short, not longer than half their distal width.

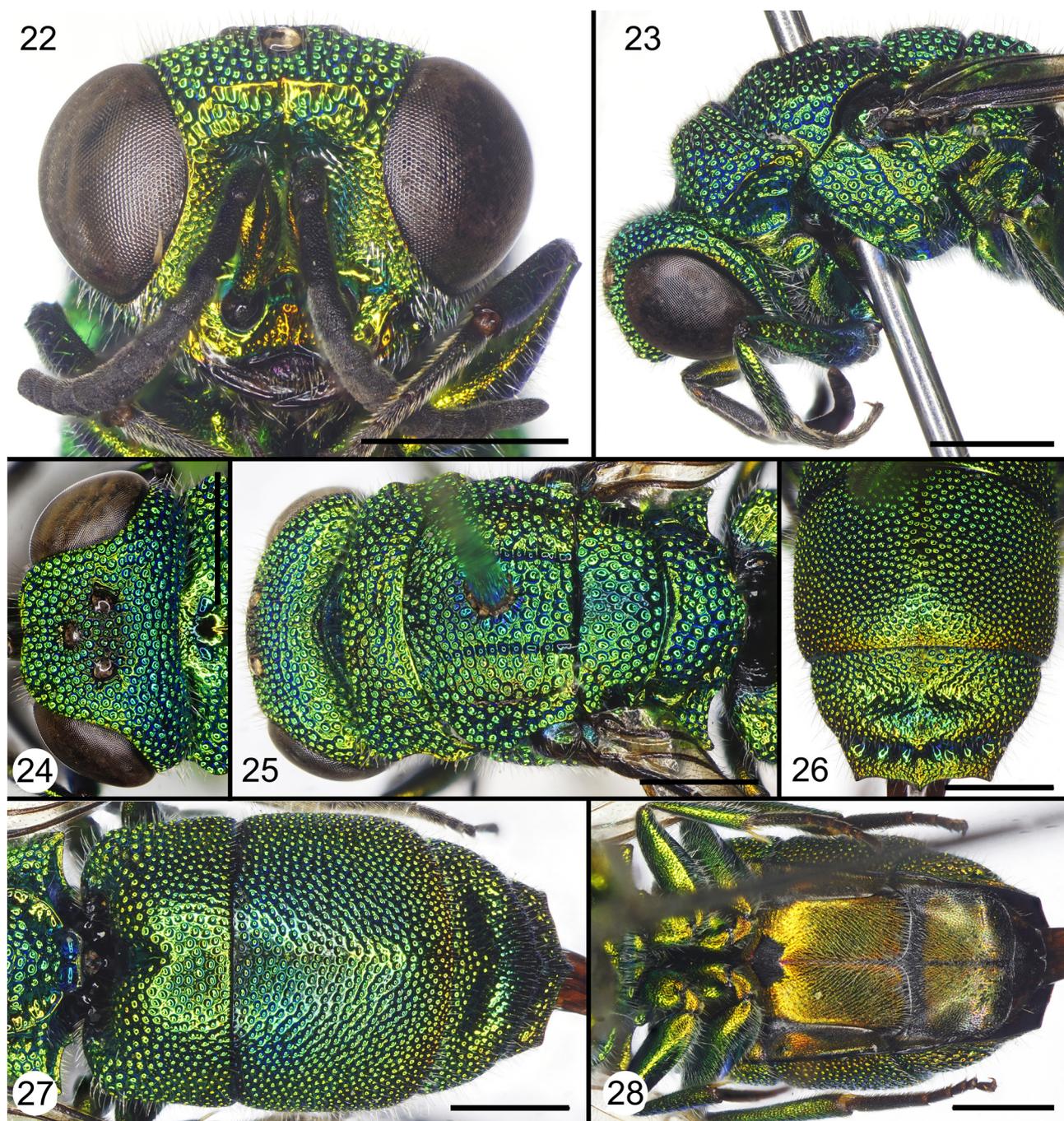
Metasoma. Metasoma densely punctate; punctures smaller than on mesosoma. Interstices on T1 and T2 $0.2\text{--}1.0 \times$ PD, polished, almost smooth, with only scattered tiny punctures. T2 with weak median carina, almost reaching posterior margin. T3 punctate and wrinkled before prepit bulge (Fig. 19); prepit bulge slightly convex (Fig. 26); pits large, apical rim wrinkled (Figs 19, 26). Median tooth on apex of T3 sharp and pointed, lateral teeth shorter (Figs

19, 26). Interval between median tooth and lateral tooth broadly incurved. S2 black spots trapezoid, fused medially, forming black mark wider than its length (Fig. 28).

Colouration. Body metallic golden green, with some dark brown to olive or blue reflections on pronotum, mesoscutum, mesoscutellum, metanotum and laterally on mesosoma. Terga golden green. Median blue spots on mesoscutum small. Scape metallic green, dorsal part of pedicel metallic copper, rest of flagellum black. Tegula brown in the holotype (Fig. 18), yet predominantly metallic green in recently collected specimens, with only outer margin partly brownish-black. Wings slightly infusate. Legs metallic bright green, basitarsi greenish, rest of tarsi blackish.

Male. Unknown.

Distribution. Northern and central Vietnam (Cao Bang & Ha Tinh Provinces).



FIGURES 22–28. *Trichrysis tonkinensis* (Mocsary, 1914), ♀ from Vietnam: Cao Bang, Nguyen Binh, Quang Thanh. 22. Head, frontal view. 23. Head and mesosoma, lateral view. 24. Head, dorsal view. 25. Head and mesosoma, dorsal view. 26. T2 and T3, posterior view. 27. Metasoma, dorsal view. 28. Metasoma, ventral view. Scale bar = 1 mm.

Remarks. The Chinese specimen identified as *Trichrysis tonkinensis* and illustrated in Rosa *et al.* (2016) resulted undescribed (see below *T. sinica*), and we here provide the images of the holotype of *T. tonkinensis* photographed at HNHM (Figs 16–21).

Trichrysis tonkinensis is similar to *T. chamchuensis* Wiśniowski & Nguyen in Wiśniowski *et al.* (2020) but can be differentiated from the latter by the following characters: BOL $1.5 \times \text{MOD}$, F1 l/w=2.6, OOL $1.9 \times \text{MOD}$ (vs. BOL $1.7 \times \text{MOD}$, F1 l/w=3.0, OOL $1.4 \times \text{MOD}$ in *T. chamchuensis*); malar space with few medium punctures (vs. few small punctures); interstices of T1 and T2 narrower, $0.2\text{--}1.0 \times \text{PD}$ (vs. $0.6\text{--}1.2 \times \text{PD}$); T2 with weak median carina, reaching approximately one-third to apex of T2 (vs. T2 with distinct median carina, reaching apex of T2); pits large, not fused into pair of elongated holes on both sides of median keel (vs. pits fused into pair of elongated holes on both sides of median keel); S2 black spots trapezoid (vs. S2 black spots almost triangle); dorsal part of pedicel metallic copper (vs. pedicel metallic green).

Discussion

The taxa of the *cyanea* species group have been the subject of systematic studies in Vietnam for quite a short period of time. The first results of field research carried out by the IEBR staff (VAST, Hanoi) were published in 2020 and brought the description of four species new to science: *T. aliciae* Wiśniowski in Wiśniowski *et al.*, 2020; *T. chamchuensis* Wiśniowski & Nguyen in Wiśniowski *et al.*, 2020; *T. kylan* Wiśniowski & Nguyen in Wiśniowski *et al.*, 2020; and *T. raymundi* Wiśniowski in Wiśniowski *et al.*, 2020. In the present article, another species is described. Before our research, only one species of the *cyanea* group was known from Vietnam, namely *T. tonkinensis* (Mocsáry, 1914). Currently, eight species of *Trichrysis* are known from the country, including six from the *cyanea* group. Future studies will focus on members of other species groups, from Vietnam and the Oriental region to provide keys and distributional maps.

Data on the genus *Trichrysis* in the Oriental region were recently published from China (Rosa *et al.* 2014, 2016; species from both the Palearctic and Oriental parts of the country) and India (Rosa *et al.* 2021, 2022). The genus is only sporadically studied in other countries of the region, and so far 18 taxa of the *cyanea* species group are known from the Oriental region (Bohart 1988; Kimsey & Bohart 1991; Rosa *et al.* 2014, 2016, 2021, 2022; Wiśniowski *et al.* 2020, and the present paper). Descriptions of other new species in the *cyanea* group and revisions with keys are in print (e.g. Rosa *et al.* 2022) or in preparation, for the *lusca* group from Vietnam, therefore the number of species in this genus will be quickly improved thanks to field research.

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