

A new species and new records of cuckoo wasps from Pakistan and India (Hymenoptera, Chrysididae)

Paolo Rosa¹, Daniele Baiocchi², Marek Halada³, Maxim Yu. Proshchalykin⁴

1 University of Mons, Laboratory of Zoology, Place du parc 20, 7000 Mons, Belgium **2** Via Matteo Babini 26, I-00139 Roma, Italy **3** Milady Horákové 74, 37012 České Budějovice, Czech Republic **4** Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far East Branch of the Russian Academy of Sciences, Vladivostok 690022, Russia

Corresponding author: Paolo Rosa (rosa@chrysis.net)

Academic editor: V. Gokhman | Received 3 March 2021 | Accepted 4 April 2021 | Published 24 August 2021

<http://zoobank.org/A2FD2F42-C115-4E73-8317-10BABF8A630B>

Citation: Rosa P, Baiocchi D, Halada M, Proshchalykin MYu (2021) A new species and new records of cuckoo wasps from Pakistan and India (Hymenoptera, Chrysididae). In: Proshchalykin MYu, Gokhman VE (Eds) Hymenoptera studies through space and time: A collection of papers dedicated to the 75th anniversary of Arkady S. Lelej. Journal of Hymenoptera Research 84: 283–294. <https://doi.org/10.3897/jhr.84.65439>

Abstract

Chrysis arkadyi **sp. nov.** from India and Pakistan is herein described in the *C. splendidula* species group, and *C. speculata* du Buysson, 1896 is recorded for the first time from Pakistan. The *Chrysis autocrata* species group, established by Linsenmaier (1997), is synonymised with the *C. succincta* species group, and the *C. serpentula* species group, established by Tarbinsky (2002), is synonymised with the *C. splendidula* species group. *C. autocrata* Nurse, 1903 **syn. nov.** and *C. ewridica* Tarbinsky, 2001 **syn. nov.** are considered junior synonyms of *C. variana* du Buysson, 1901. A key to the seven species of the *C. succincta* species group so far known from Pakistan and India is provided.

Keywords

Chrysidini, distribution, species groups, synonymy, taxonomy

Introduction

The Chrysididae of India were recently reviewed by Rosa et al. (2021), who listed 105 species for the country. The Pakistani fauna of cuckoo wasps is instead quite poorly known and only about fifty species have been recorded for the country. The most active

researcher for this country was Colonel Charles George Nurse (1862–1933) who, as many other entomologists, began by collecting butterflies and moths, and in later years he extended his interest to other orders of insects, in particular to Hymenoptera. Thanks to his studies and collected material, more than 200 new species were added to the Hymenoptera fauna of India, although he described relatively few species himself, the rest being described by Cameron, Bingham and Morley. Nurse (1902, 1903a, b, 1904) described some cuckoo wasps mostly collected in the area of Quetta, along the Jhelum river, and in other localities that are currently located in modern day Pakistan. Besides Nurse's publications of new taxa, other descriptions of Pakistani species were provided in the fundamental work published by Bingham (1903) 'The Fauna of British India, including Ceylon and Burma. Hymenoptera, Vol. II. Ants and Cuckoo-wasps'. Since then, only sporadic descriptions of new species, or new distributional records, were published by Linsenmaier (1959, 1968, 1997), Rosa (2018b, 2019) and Rosa et al. (2021).

The aim of the present paper is to describe a strange new species from the *Chrysis splendidula* species group, to report a new Pakistani record for the *C. succincta* species group, and to provide a key to the currently known Indian and Pakistani species of the latter species group.

Materials and methods

The present study is based on material collected in 2003, 2013 and 2019 during three different entomological surveys in Pakistan (Khyber Pakhtunkhwa) and in India (Uttarakhand).

Examined specimens are deposited in the private collections of the authors: Paolo Rosa (PRC), Marek Halada (MHC) and Daniele Baiocchi (DBC). The holotype of *Chrysis arkadyi* sp. nov. is deposited in the Museo Civico di Storia Naturale, Milan, Italy (MSNM). Further specimens examined for this study were examined in the following museums: Biological and Geological Institute, Bishkek, Kyrgyzstan (BGIB); British Museum of Natural History, London, UK (NHMUK); Magyar Természettudományi Múzeum, Budapest, Hungary (HNHM); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Naturhistorisches Museum Wien, Austria (HNMW); Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (ZIN).

Abbreviations used in the descriptions are as follows: **cat.** = catalogue; **descr.** = description; **diagn.** = diagnosis; **F1, F2, F3, etc.** = flagellomeres 1, 2, 3, etc., respectively; **MOD** = median ocellus diameter (measured in frontal view); **MS** = malar space, the shortest distance between base of mandible and lowest margin of compound eye; **OOL** = oculo-ocellar line, the shortest distance between posterior ocellus and compound eye; **P** = pedicel; **POL** = posterior ocellar line, the shortest distance between posterior ocelli; **S** = metasomal sternum; **T** = metasomal tergum.

Images were taken with a Nikon D700 (specimens) and Nikon D3200 (internal segments) photocaleras connected to a Togonal SCZ stereoscope. Images were stacked with CombineZP software.

Taxonomy

Chrysis splendidula species group

Chrysis splendidula group: Linsenmaier 1959: 124 (key), 127 (diagn.). Kimsey and Bohart 1991: 328 (key), 362 (diagn.).

Chrysis splendidula s.str. subgroup: Kimsey and Bohart 1991: 332 (key), 362 (diagn.).

Chrysis serpentula group: Tarbinsky 2002: 18 (diagn.), syn. nov.

Diagnosis. The *splendidula* species group includes Palaearctic species recognizable by the last metasomal tergum which is coloured blue or green, usually contrasting with metasomal terga I–II which are red. However, exceptions to this colouration pattern are five Central Asian species with terga I–II blue or blue with green to light blue stripes (*Chrysis centralis* Semenov-Tian-Shanskij, 1967; *C. circassica* Mocsáry, 1893; *C. hyacinthus* Semenov-Tian-Shanskij, 1967; *C. kokandica* Radoszkowsky, 1877; *C. serpentula* Semenov-Tian-Shanskij, 1967) and a Japanese one (*C. nohirai* Tsuneki, 1952).

Members of the *splendidula* species group can be recognised by the combination of the following characters: transverse frontal carina distinct and raised; apical margin of metasomal tergum III with four sharp teeth, and black spots on sternum II elongate, connected to lateroterga and widely separated in the middle (Fig. 1F).

Description. Face with distinct and raised transverse frontal carina, M-like or biconvex, recurved below; scapal basin medially polished to finely wrinkled; malar spaces usually 1.0–1.5 × MOD; second flagellomere usually slightly shortened; carina on metasomal tergum II indistinct or as an impunctate line, rarely raised and sharp; tergum III with distinct row of small, round to slightly elongate pits; apical margin of tergum III with four sharp, triangular teeth; black spots on sternum II widely separated and elongate, adjacent to lateral margin.

Hosts. Vespidae: Eumeninae (Martynova and Fateryga 2015).

Remarks. Kimsey and Bohart (1991) subdivided the *splendidula* species group into two subgroups: the *splendidula* s.str. subgroup and the *splendidula-senegalensis* subgroup. We here consider these two groups as separated because of the different shape of female internal terga that form the telescopic ovipositor (Rosa et al., in preparation).

Chrysis arkadyi sp. nov. is the only known member of the *splendidula* group from India and Pakistan so far. Conversely, four species of the *senegalensis* group are known for India (Rosa et al. 2021), namely: *Chrysis disparilis* Cameron, 1897, *C. hecate* Mocsáry, 1889, *C. ionophris* Mocsáry, 1893, and *C. sikkimensis* Mocsáry, 1912.

Tarbinsky (2002) established the *serpentula* species group, based on misidentified specimens of *Chrysis serpentula* Semenov-Tian-Shanskij, 1967. After type examination (Rosa et al. 2017, fig. 122) we include this species in the *splendidula* species group and we here synonymize the *serpentula* species group with the *splendidula* species group.

***Chrysis arkadyi* sp. nov.**

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Figs 1, 2

Material examined. *Holotype*, ♀, INDIA: Uttaranchal: Haldwani, Kathgodam, ca 800 m, 21.–22.vii.2003, Z. Kejval & M. Trýzna leg. (MSNM). *Paratypes*: PAKISTAN: 1♂, Khyber Pakhtunkhwa: NE of Mansehra, ca 1200 m, Barhadi env., 34°24'00"N, 73°19'48"E, 20.v.2019, D. Baiocchi leg. (DBC); 2♀♀, NE of Mansehra, ca 1200 m, Barhadi env., 34°24'00"N, 73°19'48"E, 20.v.2019, M. Kafka leg. (MHC, PRC).

Diagnosis. *Chrysis arkadyi* sp. nov. is recognised by the following characters: body blue with light blue and greenish reflections (Fig. 1), with black median area of mesoscutum, and with wide green bands laterally and posteriorly on terga I–II; metapostnotum T-like, reduced to a small median area, with punctures smaller than those on metascutellum; metasoma with terga I–II extremely elongated compared to other species in the *splendidula* species group; tergum III with polished and elongate post pit row area; black spots on sternum II elongate and sub-ovoid. This new species can be distinguished from other blue coloured Central Asian species of the same species group by reduced metapostnotum, elongated metasomal terga and elongate post pit row area. This species is more closely related to *Chrysis nohirai* Tsuneki, for the elongate shape of metasomal tergum II (type examination based on pictures taken by T. Mita). However, *C. arkadyi* sp. nov. is easily distinguished by: transverse frontal carina M-shaped; dense body punctation, in particular on mesonotum, mesopleuron and second tergum; structure of metasomal tergum I elongate, 0.6 × as long as length of tergum II and structure of tergum III with post pit row distinctly elongate (1.5 MOD) (vs. transverse frontal carina medially straight and laterally downcurved; body sparsely punctate, with wide impunctate interspaces on lateral areas of mesoscutum, mesopleuron and second tergum, and unmodified structure of tergum I, 0.4 × as long as length of tergum II and of tergum III, with post pit row not distinctly elongate (1.0 MOD) in *C. nohirai*).

Description. *Holotype: Female.* Body length 6.6 mm. **Head.** Scapal basin medially striate and laterally micropunctate (Fig. 1B). Transverse frontal carina broadly M-shaped. Anterior margin of clypeus medially not emarginate, with thickened brownish rim. Face with large and coarse punctures between transverse frontal carina and scapal basin; vertex with smaller punctures. Genal carina sharp, present from temple posteriorly to mandible. Relative length of P:F1:F2:F3 = 1.0:1.3:0.9:0.8; OOL = 2.0 × MOD; POL = 2.3 × MOD; MS = 1.3 × MOD; subantennal space 1.0 × MOD. **Mesosoma.** Pronotum slightly shorter than mesoscutellum (Fig. 1C); antero-median pronotal line deep, broad and reaching half of pronotum length; punctation double, coarse along anterior and lateral margins, with smaller punctures on antero-median pronotal line and along posterior margin. Median area of mesoscutum in posterior half with larger punctures and broader polished intervals; lateral areas of mesoscutum with irregularly sized punctures and corrugated interspaces; parapsidal furrow distinctly engraved; notauli as line of sub-square pits, decreasing towards anterior margin of mesoscutum. Mesoscutellum with larger punctures and broad, polished interspaces, locally with tiny punctures; laterally with smaller, dense punctures along metanotal trough. Metanotum slightly convex, with large, polygonal and

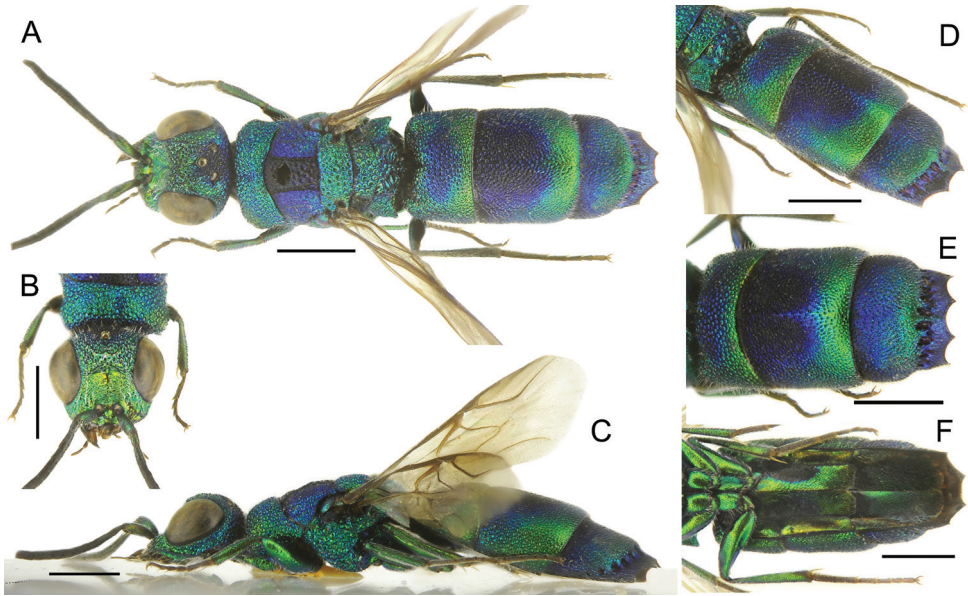


Figure 1. *Chrysis arkadyi* sp. nov., female, holotype **A** habitus, dorsal view **B** head, frontal view **C** habitus, lateral view **D** metasoma, dorso-lateral view **E** metasoma, posterior view **F** metasoma, ventral view. Scale bars: 1.0 mm.

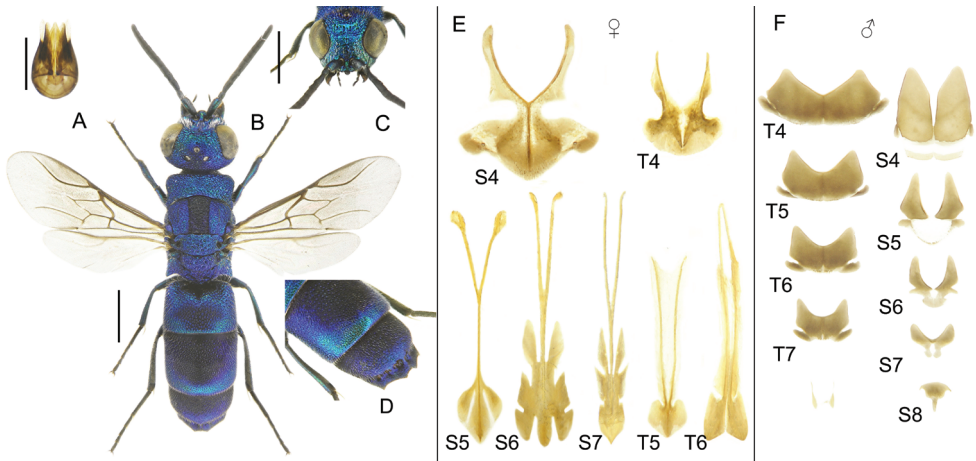


Figure 2. *Chrysis arkadyi* sp. nov., male, paratype (**A–D, F**), female, holotype (**E**) **A** genital capsule **B** habitus, dorsal view **C** head, frontal view **D** metasoma, dorso-lateral view **E, F** internalised segments. Scale bars: 1.0 mm.

uneven punctures; anterior margin of metanotum with large impunctate and depressed median area. Mesopleuron almost without trace of episternal sulcus, with large punctures and densely, minutely punctate intervals; scrobal sulcus as deep, polished line (Fig. 1A); metapostnotum reduced, triangular, T-shaped, with small punctures and with two largely expanded lateral areas, with raised transverse carinae; posterior propodeal projections lat-

erally expanded and downward directed, with basal margin slightly concave. **Metasoma.** Metasoma densely punctate; puncture diameter about 1/2 to 1/3 of largest punctures on mesoscutellum; metasomal terga elongate (Fig. 1C–F), tergum I 0.6 × as long as length of tergum II; tergum III slightly longer than tergum I; tergum II with weak median ridge; pit row of tergum III deep, with elongated, large pits; post pit row distinctly elongate (1.5 MOD); apex of T3 with four short, triangular teeth; intervals between median and lateral teeth almost equal; black spots on sternum II sub-ovoid, narrow and connected to lateral margins, widely separated medially (Fig. 1F). **Colouration.** Body blue to deep blue, almost black on ocellar area, median area of mesoscutum and basally on metasomal tergum II; green on scape, pedicel, first flagellomere, postero-laterally on terga I–II, on tergum III pre pit row, and on sternites (Fig. 1C–F); other flagellomeres black; tegula light blue; post-tegula bright metallic blue; forewing slightly infusate, with darkened radial cell.

Male. Similar to female (Fig. 2A–D), with deep blue body colour and fewer greenish hints. Paratype body length 6.2 mm. The main dimorphic difference is observed in the metasomal tergum III for shorter post pit area and apical margin with median teeth shorter and closer to each other, compared to apical teeth of female.

Ecology. The Pakistani specimens of *Chrysis arkadyi* sp. nov. described herein were captured by means of yellow pan traps positioned along one of the roads through the forest zone of the Manshera district, about one kilometer NE of the village of Barhadi. The forest is mainly composed of *Pinus roxburghii* Sargent (Fig. 4).

Etymology. The specific epithet *arkadyi* is a patronym honouring Prof. Dr. Arkady Stepanovich Lelej on the occasion of his 75th birthday and in recognition of his numerous contributions to the study of the Hymenoptera and of the Russian Chrysididae.

***Chrysis succincta* species group**

Chrysis succincta group: Linsenmaier 1959: 92 (key), 106 (diagn.). Kimsey and Bohart 1991: 324 (key), 363 (diagn.).

Chrysis succincta s.str. subgroup: Kimsey and Bohart 1991: 362 (diagn.).

Chrysis autocrata group: Linsenmaier 1997: 275, syn. nov.

Diagnosis. The *succincta* species group includes more than a hundred species distributed worldwide, with a large majority known in the Palearctic region, and subdivided into *succincta* s.str. subgroup and *leachii* subgroup (or *leachii* group according to Linsenmaier 1959). Usually, Palearctic species are easily recognised by their slender habitus and by their peculiar colouration, with the body largely red coloured. The most diagnostic feature is anyhow the prominent brow, often ridge-like, and the transverse frontal carina which is usually only partially developed; females scapal basin is always polished medially in the *succincta* s.str. subgroup, whereas it is finely striated in the *leachii* subgroup, while in males it is finely punctate in both subgroups. The apical margin of tergum III is highly variable, bearing from none to four teeth or two median teeth almost fused together and projecting medially.

Hosts. Crabronidae (Pauli et al. 2019).

Remarks. Linsenmaier (1997) established the *autocrata* species group, based on *Chrysis autocrata* Nurse, 1903. After type examination of the latter, we propose the new synonymy *Chrysis variana* du Buysson, 1901 = *Chrysis autocrata* Nurse, 1903, syn. nov. *Chrysis variana* (see pictures of the type in Rosa et al. 2020) is a widespread Central Asian species of the *succincta* group (known from Kazakhstan, Kyrgyzstan, Tadjikistan, Turkmenistan and Pakistan), and apparently unknown to Linsenmaier, as it is not listed in his papers and was not found in his collection. Consequently, we synonymize the *autocrata* species group with the *succincta* species group, because it is not sufficiently supported by morphological diagnostic characters. During the examination of the Palaearctic types of cuckoo wasps, the first author also observed that the holotype of *Chrysis ewridica* Tarbinsky, 2001 (described from Kyrgyzstan, Jalal-Abad) is a female of *Chrysis variana* and therefore we here propose also the new synonymy *Chrysis variana* du Buysson, 1901 = *Chrysis ewridica* Tarbinsky, 2001, syn. nov.

***Chrysis speculata* du Buysson, 1896**

Fig. 3A–F

Chrysis speculata du Buysson, 1896: 473. Holotype: ♀; India: Maharashtra: Bombay: Poona [= Pune] (471 (key), 473–474 (descr.), pl. III (fig. 4)) (MNHN) (examined). Bingham 1903: 437 (key), 465 (descr., Bombay: Poona [= Pune]); Kimsey

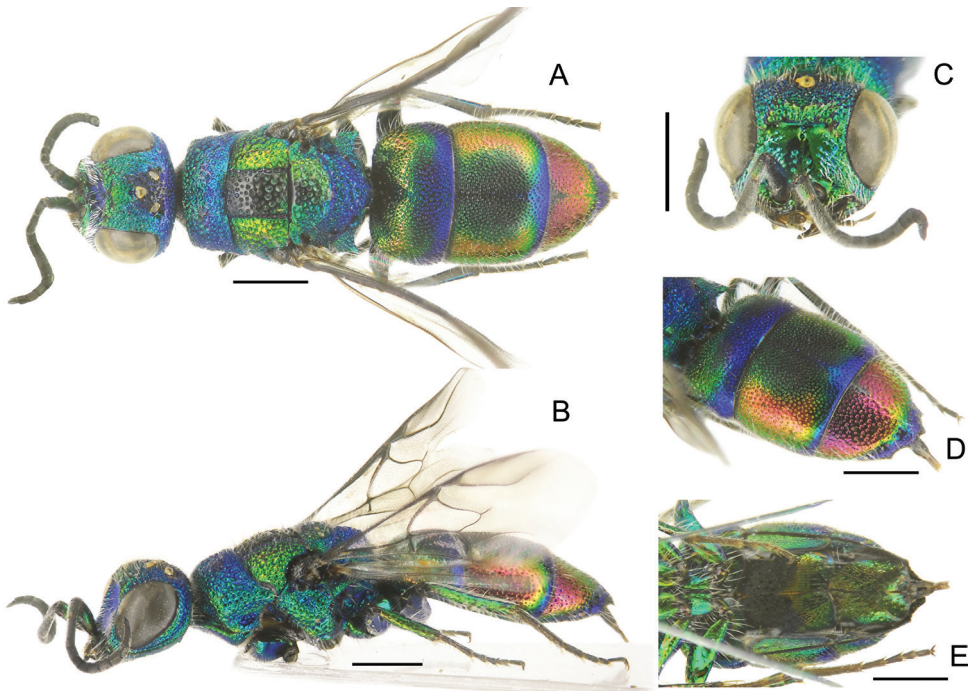


Figure 3. *Chrysis speculata* du Buysson, female, from Pakistan **A** habitus, dorsal view **B** habitus, lateral view **C** head, frontal view **D** metasoma, dorso-lateral view **E** metasoma, ventral view. Scale bars: 1.0 mm.

and Bohart 1991: 464 (cat., India: Bombay: Poona [= Pune], *succincta* s.s. group);
Rosa et al. 2021: 29 (cat., India, Sikkim), 30 (fig. 23).

Chrysis (Tetrachrysis) speculata: Bischoff 1913: 59 (cat., India).

Material examined. PAKISTAN: 1♀, Khyber Pakhtunkhwa: NE of Mansehra, ca 1200 m, Barhadi env., 34°24'00"N, 73°19'48"E, 20.v.2019, M. Kafka leg. (MHC).

Distribution. Pakistan (Khyber Pakhtunkhwa, first record), India (Maharashtra), Nepal (Chhumchaur, 29°21'30"N, 82°23'46"E, 16.vi.1997 (PRC)) (new record).

List of the recorded species of the *succincta* s.str. subgroup from India and Pakistan

Chrysis begam Mocsáry, 1912: 554. Holotype: ♀; India: Sikkim (HNHM).

Chrysis chavanae Nurse, 1902: 308. Holotype: ♀; Pakistan: Quetta (NHMUK).

Chrysis kokuevi Semenov-Tian-Shanskij, 1967: 178. Holotype: ♂; n China: Dyn-yuan-in oasis (ZIN). Kimsey and Bohart 1991: 428 (Pakistan).

Chrysis paria Bingham, 1903: 455. Holotype: ♂; Pakistan: Baluchistan, Quetta (NHMUK) [= *C. sara* Nurse, 1904: 20. Holotype: ♂ (not ♀); Pakistan: Baluchistan, Quetta (NHMUK). Included in the genus *Allochrysis* by Kimsey and Bohart 1991, transferred to the *succincta* species group by Rosa (2018a)].

Chrysis speculata du Buysson, 1896: 473. Holotype: ♀; India: Maharashtra: Bombay: Poona [= Pune] (MNHN).

Chrysis urana Nurse, 1904: 22. Lectotype: ♀, designated by Bohart in Kimsey and Bohart 1991; Pakistan: Quetta (NHMUK).

Chrysis variana du Buysson, 1901: 103. Holotype: ♀; Turkmenistan: Imam Baba (NHMW) [= *C. autocrata* Nurse, 1903b: 40. Lectotype: ♀, designated by Bohart in Kimsey and Bohart 1991; Pakistan: Quetta (NHMUK), syn. nov.; = *C. ewridica* Tarbinsky, 2001. Holotype: ♀; Kyrgyzstan: Jalal-Abad (BGIB), syn. nov.].

Key to the Indian and Pakistani species of the *succincta* s.str. group

- 1 Apical margin of tergum III edentate..... ***Chrysis chavanae* Nurse**
- Apical margin of tergum III with three or four teeth..... **2**
- 2 Apical margin of tergum III with three aligned teeth and median one apically rounded in male, or with protruding median tooth in female; small species (body length 3.0–5.0 mm)..... ***Chrysis paria* Bingham**
- Apical margin of tergum III with four teeth; medium to large species (body length 5.5–8.5 mm)..... **3**
- 3 Body colour entirely blue or blue with light blue to greenish reflections..... **4**
- Body bicoloured, with head and mesosoma green to blue, with mesonotum concolour or golden-red, and red metasoma, or with head and mesosoma green to blue and with tergum I greenish, contrasting with red terga II–III **5**

- 4 Large sized species, body length 6.8 mm. Female scapal basin largely polished; with four large teeth on apical margin of tergum III, and with two median ones larger and distinctly protruding; black spots on sternum II almost medially fused, subsquare, with straight posterior margin, covering more than half segment (male unknown).....*Chrysis urana* Nurse
- Medium sized species, body length 5.3 mm. Female scapal basin largely punctate, with narrow polished median line; with four spiniform teeth on apical margin of tergum III, with two median ones slightly larger than lateral ones and slightly distinctly protruding; black spots on sternum II rounded, medially very close to each other, yet with arcuate posterior margin; black spots covering less than half segment (currently known only from India – Sikkim, male unknown).....*Chrysis begam* Mocsáry
- 5 Multicoloured species, with head and mesosoma green to blue, with mesoscutum golden-red and median area black; metasoma red with wide blue stripes on terga I–II postero-laterally, and on apex of tergum III; terga I–II dark to black medially (Fig. 3) *Chrysis speculata* du Buysson
- Bicoloured species, with head and mesosoma green to blue and metasoma entirely red or with tergum I greenish **6**
- 6 Large sized species, body length 8.0–8.5 mm. Metasoma bicoloured with tergum I greenish, with large, deep, and spaced punctures; tergum III with small pits of pit row, almost indistinguishable from other punctures of tergum; medially, before pit row, with outstanding bump; lateral teeth spine-like; black spots on sternum II small, subrectangular and medially widely separated.....
.....*Chrysis variana* du Buysson
- Small to medium sized species, body length 4.5–5.5 mm. Metasoma concoloured with small, shallow and dense punctures; tergum III with unmodified pit row; pre-pit area unmodified; lateral teeth angled; black spots on sternum II large, medially fused and covering large part of segment.....
.....*Chrysis kokuevi* Semenov-Tian-Shanskij

Conclusions

Indian cuckoo wasp fauna is now updated to 106 species in 20 chrysidid genera and four subfamilies. On the other hand, the Pakistani fauna is still too poorly known and under-studied, and any tentative estimate of its richness and composition cannot be carried out at this moment. It currently includes only members of the Chrysidinae subfamily, specifically 37 species belonging to four genera of Chrysidini (86% species in the genus *Chrysis* Linnaeus, 1761), two species of two genera of Parnopini, and nine species of five genera of Elampini. From future field studies in Pakistan, we expect records of the subfamily Cleptinae, whereas we do not expect any record of Amiseginae and Loboscelidiinae, being egg parasitoids of Phasmatodea and therefore related to



Figure 4. Pakistan, type locality of *Chrysis arkadyi* sp. nov., forest composed of *Pinus roxburghii*.

their occurrence in the area. Moreover, the Pakistani fauna is currently mostly related to the Palearctic one, based on the limited material available for inspection in museum collections, predominantly consisting of types.

Acknowledgements

We are thankful to Zbyněk Kejval, Miloš Trýzna and Marek Kafka (all from Czech Republic) for providing the type material of *Chrysis arkadyi*, Toshiharu Mita (Fukuoka, Japan), Villu Soon (Tartu, Estonia) and Bogdan Wiśniowski (Rzeszów, Poland) for reviewing the manuscript, Thomas Wood (Mons, Belgium) for English proofreading, and Vladimir Gokhman (Moscow, Russia) for editing.

Maxim Proshchalykin, a co-author of this study, was funded by RFBR and MECSS, project number 20-54-44014. The authors have declared that no competing interests exist.

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