



## A new species of *Cryptoperla* Needham, 1909 (Plecoptera: Peltoperlidae) from Guangxi of China, based on male, female, and larval stage

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### Abstract

*Cryptoperla teana* sp. n. is described from male and female adults, larvae, and exuviae collected on the plateau of the Daming Mountains, Guangxi Zhuang Autonomous Region, of southern China. The present discovery represents the first record of the family Peltoperlidae in Guangxi. The distribution of its congeners is illustrated on a map.

**Key words:** *Cryptoperla teana* sp. n., Damingshan, Oriental Region, distribution

### Introduction

Peltoperlidae is a small family of systelognathan Plecoptera distributed in the Nearctic, Oriental, and East Palaearctic region (DeWalt *et al.* 2018). The monotypic Microperlinae is restricted to China and Japan, whereas Peltoperlinae is distributed over most of Asia and North America. Three genera of the Peltoperlinae are endemic to Asia, while *Yoraperla* Ricker, 1952 and *Soliperla* Ricker, 1952 occur on both continents (Stark & Sivec 2007a, Huo *et al.* 2017). The genus *Cryptoperla* Needham, 1909 is the far most speciose genus of the family, with 30 valid species amongst 10 that are known from mainland China. Most of these are found in the Oriental region but enter also the Palaearctic in Japan (Stark & Sivec 2007a, 2007b).

During March of 2015, we took a collecting expedition to central and southwestern areas of Guangxi Zhuang Autonomous Region of southern China. Some of the results of our trip have been previously already published (Li *et al.* 2017a, b, Kontschán *et al.* 2015) but descriptions of several further stoneflies are still in progress. Herein, we report the only Peltoperlidae collected on the Damingshan Plateau that proved to be a new species and the first record of the family from Guangxi. In addition, we present a map on the previous published records for the genus.

### Material and methods

Larvae and exuviae were collected by aquatic net and searching under stones along the edge of seeps and streams. Adults were reared from larvae kept alive between moss and moist leaves in plastic tubes. Types are deposited in the Insect Collection of Henan Institute of Science and Technology (HIST), Xinxiang, China and the Collection of Smaller Insect Orders, Department of Zoology, Hungarian Natural History Museum (HNHM), Budapest, Hungary, respectively, as indicated in the text. Types were preserved in 75% ethanol. Illustrations were made with the aid of a Leica S8APO and a Nikon SMZ1500 microscope, further colour illustrations were made with the aid of Imaging Source CCD attached to Leica M420 microscope. Morphological terminology primarily follows that of Stark & Sivec (2007a).

Distribution data were compiled from the following papers: Banks (1938, 1940), Du & Sivec (2005), Huo & Du (2018), Kato *et al.* (2013), Kawai (1968a, 1968b), Klapálek (1913), Maruyama (2002), Needham (1909), Okamoto (1912), Sivec (1995, 2005), Stark (1989), Stark & Sivec (2007a, 2007b), Uchida & Isobe (1988), Wu (1973), Wu & Claassen (1934), Zwick (1977), Zwick & Sivec (1980).

## Results

### *Cryptoperla teana* Li & Murányi, sp.n.

(Figs. 1–40)

**Type materials:** Holotype male (HIST), China: Guangxi Zhuang Autonomous Region, Wuming County, Damingshan National Natural Reserve, seep at Golden Turtle Waterfall, 1150 m, 23°30.373'N, 108°26.141'E, 2015.III.21, leg. J. Kontschán, J.Y. Li, S. Li, W.H. Li, D. Murányi, G.Q. Wang. Paratypes: same locality and date: 1 female and its exuviae (HNHM: No. PLO54); Damingshan National Natural Reserve, inflow stream above Dragon Lake, 1225 m, 23°29.751'N, 108°26.242'E, 2015.III.22, leg. J. Kontschán, J.Y. Li, S. Li, W.H. Li, D. Murányi, G.Q. Wang.: 15 larvae, 2 exuviae (HNHM: No. PLO60).

**Adult.** General body color light brown with yellow pattern. Biocellate, distance between ocelli about two times the diameter of the ocellus. Head mostly brown but with distinct pale patches around ocelli in dorsal view, and a pale crossbar continuing medially to clypeus on the downcurved apex of head, as seen in frontal view (Figs. 1–2, 18–19). Occipital suture indistinct, occipital rugosities scarce and barely seen; compound eyes black and hairy, antennae brown, mouthparts and palpi pale. Pronotum brown with distinct pale rugosities (Figs. 1, 19). Mesonotum and metanotum ventrally pale with paired longitudinal brown patches laterally, scutum chocolate brown; metathoracal postscutellum with pale, worm-like paired mediolateral process dotted by short, sensilla-like setae (Fig. 20). Wing membrane brownish, veins dark brown; femora and tibiae pale brown, tarsi dark. Abdominal segments mostly pale brown to yellowish.

**Male.** Forewing length ca. 11.8 mm, body length ca. 9 mm. Terminal 3 segments with brownish terga and distinct lateral marking (Figs. 3–5), posterior half of tergum 10 downcurved (Fig. 9), and the margin parabolic in rear view (Fig. 9). Basal cercal segment ca. 5X long as basal with and distal half with reddish brown dense, spur-like hair fringe along inner margin, longest hair ca. 2X long as the cercal width (Figs. 3, 7–8, 11, 13, 15); cercal spur absent. Vesicle of sternum 9 ca. 0.6X long as wide, apex with an interrupted row of long hairs (Fig. 6). Aedeagus (Figs. 10–14, 16–17): basoventrally with conical lower lobe at each lateral corner with slightly coarse surface (Figs. 12–14, 17), the corresponding dorsal part forming a transverse band with rough surface with wrinkles, the posterolateral margin angled (Figs. 10–11, 16); main upper lobe much larger and spherical, without macrosetae (Figs. 11–13).

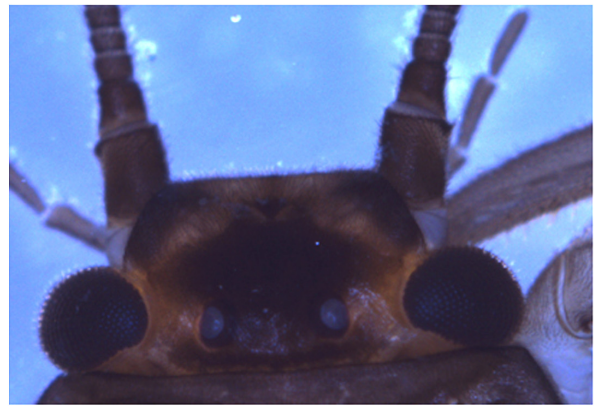
**Female:** Forewing length 13 mm, body length 10 mm; habitus and coloration similar to male. Sternum 8 with trapezoid anterior portion subdivided from the large subgenital plate; subgenital plate is broadly rounded, covers most of sternum 9, yellowish and covered by dense but short and thin setae (Fig. 21). Sternum 9 with posteromedial portion subdivided from the basal and lateral portions, white and bald; it is slightly produced posteriorly, fully covers sternum 10. Tergum 10 broadly triangular, darker than the previous terga and sterna, well overhangs paraprocts (Figs. 21–22). Paraprocts and cerci dark brown, unmodified.

Egg: unknown.

**Larva.** Body length of the female exuviae from Golden Turtle Waterfall 10 mm, larvae and exuviae from Dragon Lake smaller, 8–9 mm, female exuviae 17–18.5 mm. General color greyish dark brown, with distinct yellow and reddish patches (Figs. 24, 38 – Fig. 38 shows alive larva, Fig. 24 made on the basis of exuviae of the same specimen). Coloration of larvae from Dragon Lake less contrasting (Fig. 39). Head with yellow or pale brown occiput, brown anterior to ocelli mouthparts pale, antennae yellowish pale brown. Lacinia bidentate, teeth of equal length, marginal fringe with very long setae; galea shorter than apical tooth of lacinia, bear apical tuft of short setae (Figs. 33–34). Mandible with two molar and three incisor dens, molar well developed (Fig. 35). Pronotum brown with pale, marmorated pattern, following thoracal plates similar but with distinct yellow bars delimiting wing pads; ventral surface of thorax pale. Legs brown with distinct yellow dorsoapical patches on femora, tarsi reddish brown. Abdomen with conspicuous, wide medial yellow marking on the first three terga, following two or three terga are with paired lateral yellowish spots, terminal segments with indistinct pattern; ventral surface uniformly pale. Cerci pale brown, bit darker than antennae.



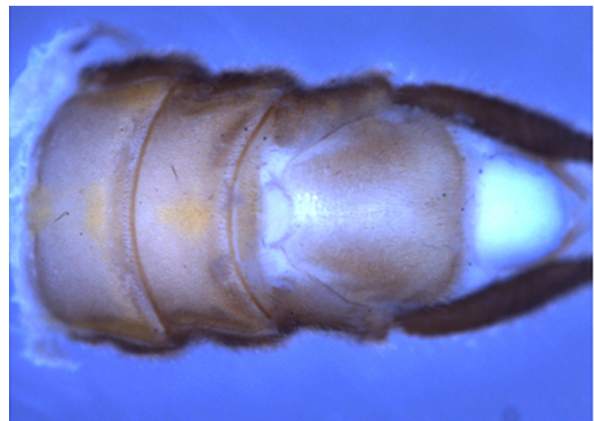
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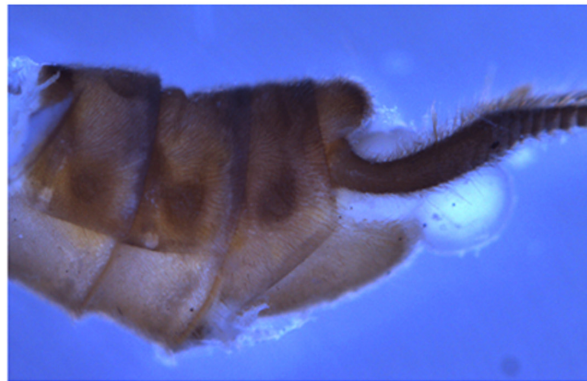
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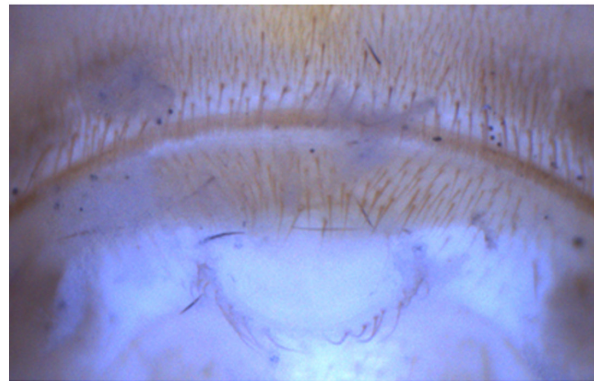
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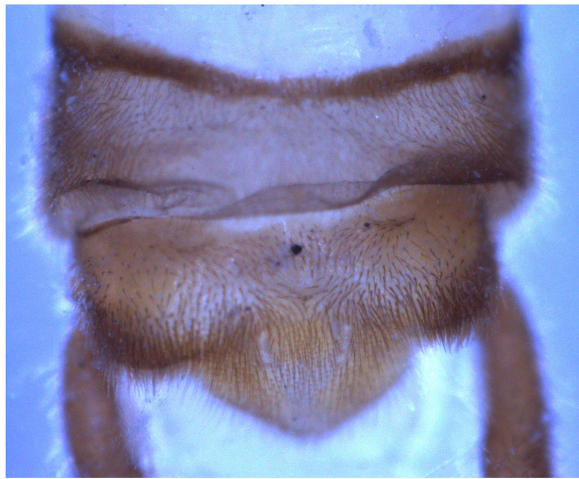
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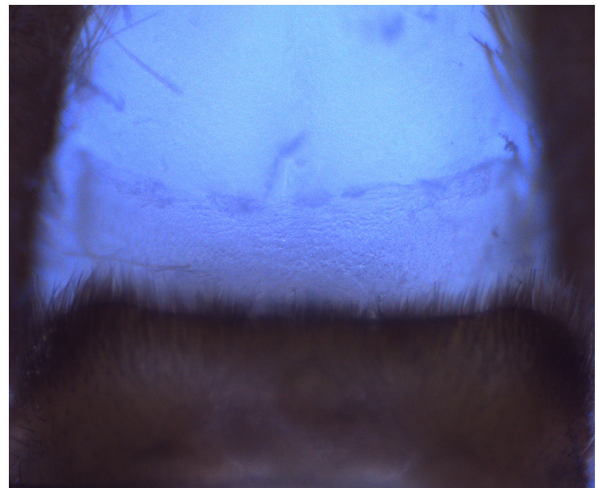
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**FIGURES 1–8.** *Cryptoperla teana* Li & Murányi, **sp. n.**, holotype male.—1: head and pronotum, dorsal view; 2: head, dorsal view; 3: terminalia, dorsal view; 4: terminalia, ventral view; 5: terminalia, lateral view; 6: vesicle, ventral view; 7: basal half of cercus, dorsal view; 8: apical segments of cercus, lateral view.

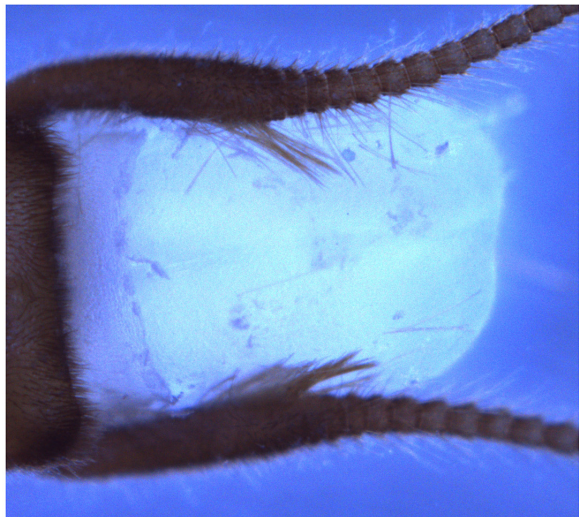




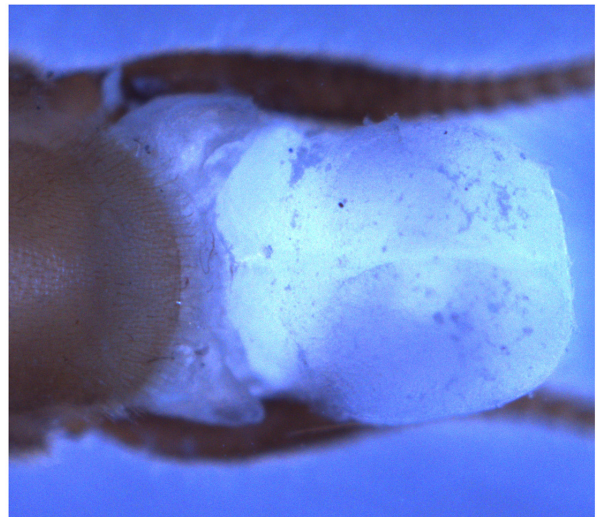
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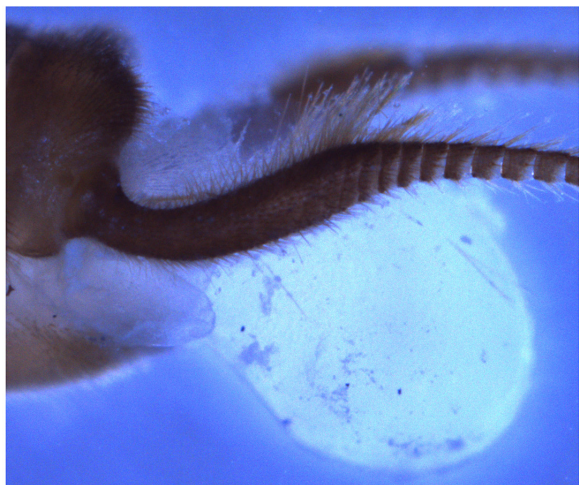
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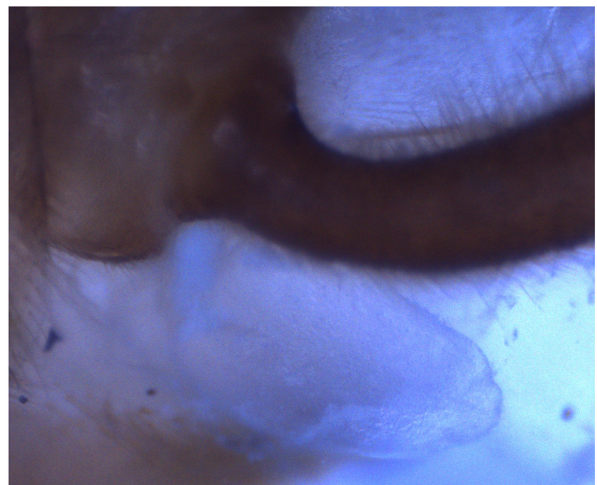
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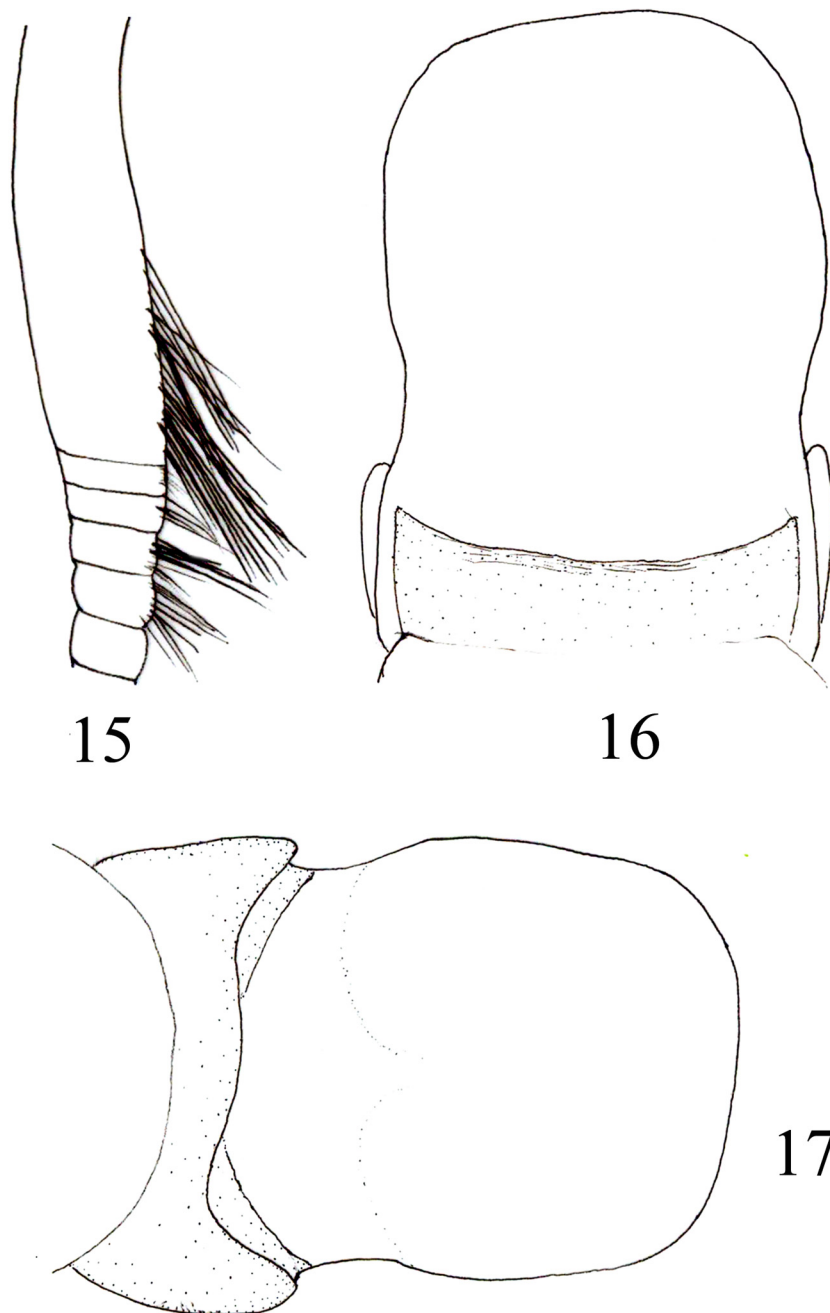
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**FIGURES 9–14.** *Cryptoperla teana* Li & Murányi, **sp. n.**, holotype male.—9: relaxed tergum 10, dorsal view; 10: basal part of aedeagus, dorsal view; 11: aedeagus, dorsal view; 12: aedeagus, ventral view; 13: aedeagus, lateral view; 14: basoventral lobe of aedeagus, lateral view.

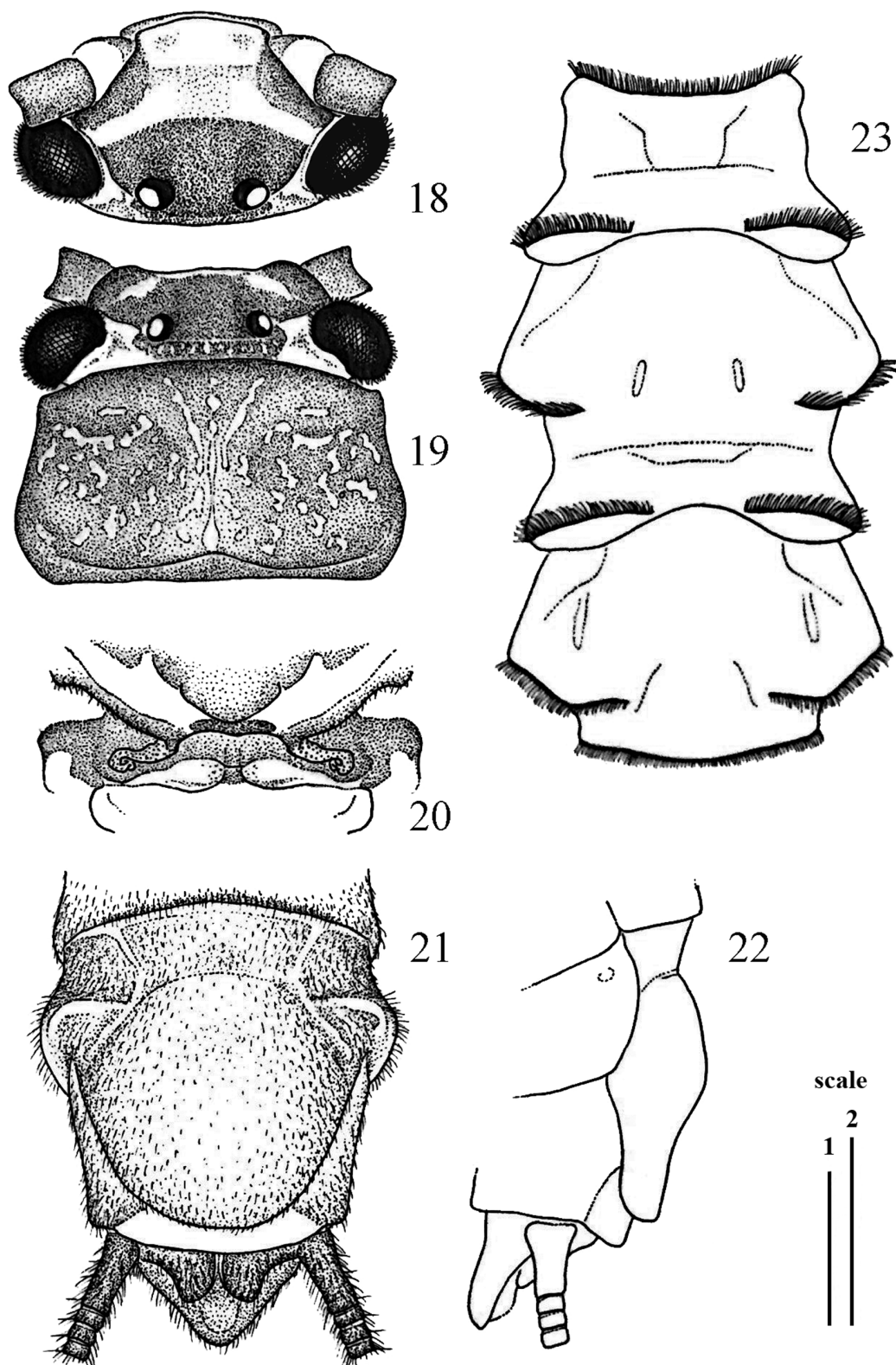




**FIGURES 15–17.** *Cryptoperla teana* Li & Murányi, **sp. n.**, holotype male.—15: basal half of cercus, dorsal view; 16: aedeagus, dorsal view; 17: aedeagus, ventral view.

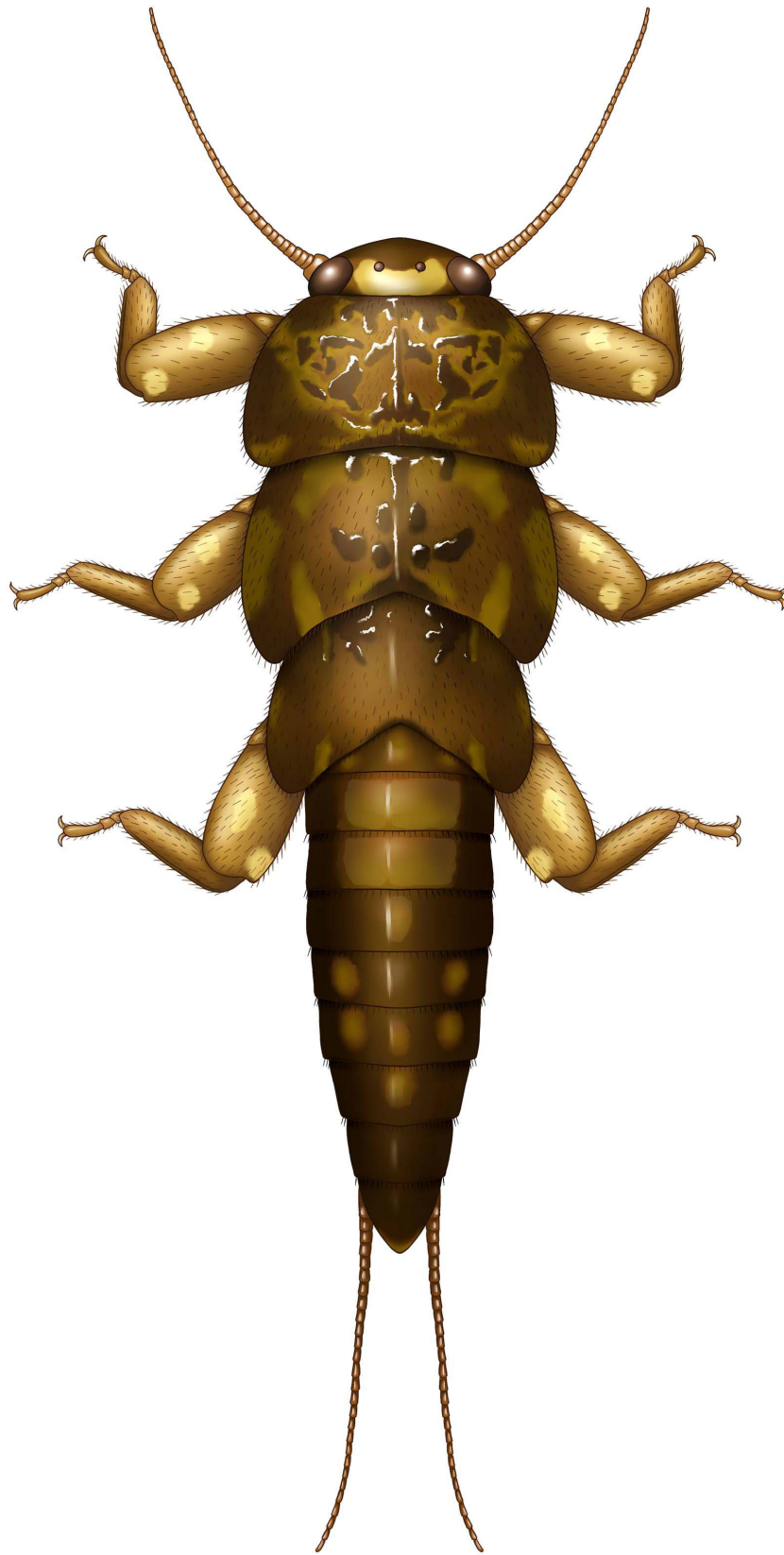
Meso- and metathoracal posterior supracoxal gills simple, elongated and acute (Figs. 29–30). Paraprocts continued in elongated triangular gills, posteriomedial gill of tergum 10 distinct and elongated (Fig. 28). Ventral setal fringes of thorax consist of complete anterior fringe and well developed posteriolateral fringes on prothorax; mediolateral and well developed posteriolateral fringes on mesothorax; well-developed mediolateral fringes and complete posterior fringe on metathorax (Fig. 23). Legs with dorsal row of swimming hairs scarce and indistinct on femora, more developed on tibiae; clothing hairs black. All abdominal sterna are with complete posterior setal fringe of long, blunt setae (Fig. 26); clothing hairs pale. Posterior setal fringe on abdominal terga consist of five to six short, clavate setae altered with long, acute setae (Fig. 25); clothing hairs black. Posterior fringe of tergum 10 lacks clavate setae but fully armed with long, acute setae. Paraprocts are with pale clothing hairs and a posterior

fringe of long, blunt setae at the origin of gills (Fig. 27). Basal segments of cerci bear distinct ventral blade-like setae in apical whorls, and dense, long intercalary hairs (Fig. 31); blade-like setae gradually weakens towards the medial portion of the cerci, apical segments are armed only with moderately long setae in apical whorls, and dense, long hairs (Fig. 32).

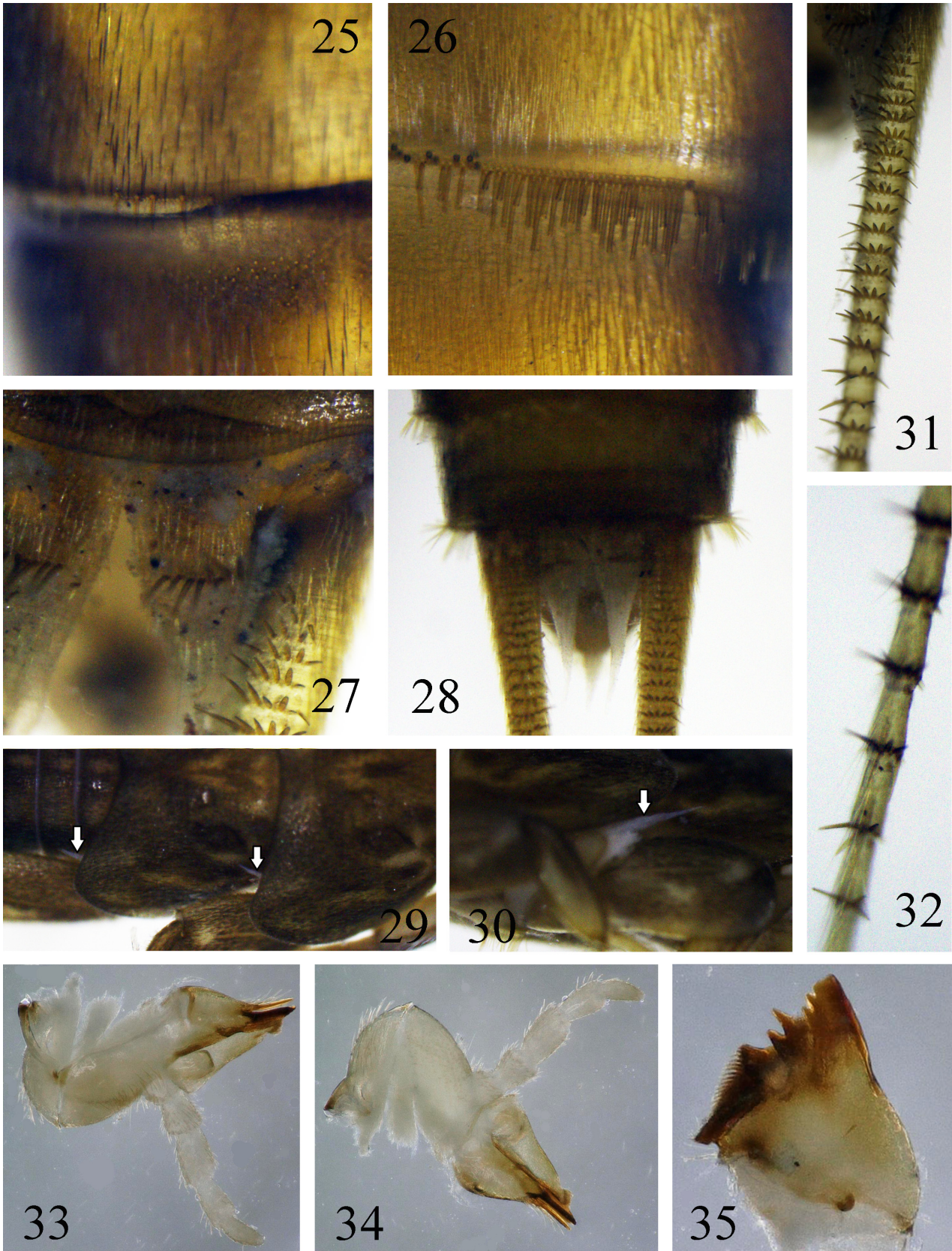


**FIGURES 18–23.** *Cryptoperla teana* Li & Murányi, sp. n., paratype female and its exuviae.—18: head, frontal view; 19: head and pronotum, dorsal view; 20: metathoracal postscutellum, dorsal view; 21: terminalia, ventral view; 22: terminalia, lateral view; 23: thorax of the exuviae, ventral view—scales 1 mm; scale 1 for Fig. 23, scale 2 for Figs 18–22.





**FIGURE 24.** *Cryptoperla teana* Li & Murányi, **sp. n.**, habitus of paratype larva; showing color pattern of pharate larva from which the paratype emerged, note that it is the same specimen as in fig. 38, not in fig. 39 showing the color patten of last instar larva from another locality.



**FIGURES 25–35.** *Cryptoperla teana* Li & Murányi, sp. n., paratype larvae and exuviae.—25: terga 5-6, dorsal view; 26: sterna 5-6, ventral view; 27: paraprocts and base of cercus, ventral view; 28: terminalia, ventral view; 29: meso- and metathorax, dorsolateral view; 30: mesothorax, lateral view; 31: basal half of cercus, ventral view; 32: apical segments of cercus, ventral view; 33: left maxilla, ventral view; 34: left maxilla, dorsal view; 35: left mandible, ventral view—not to scale; arrows on Figs. 29–30 indicate gills.





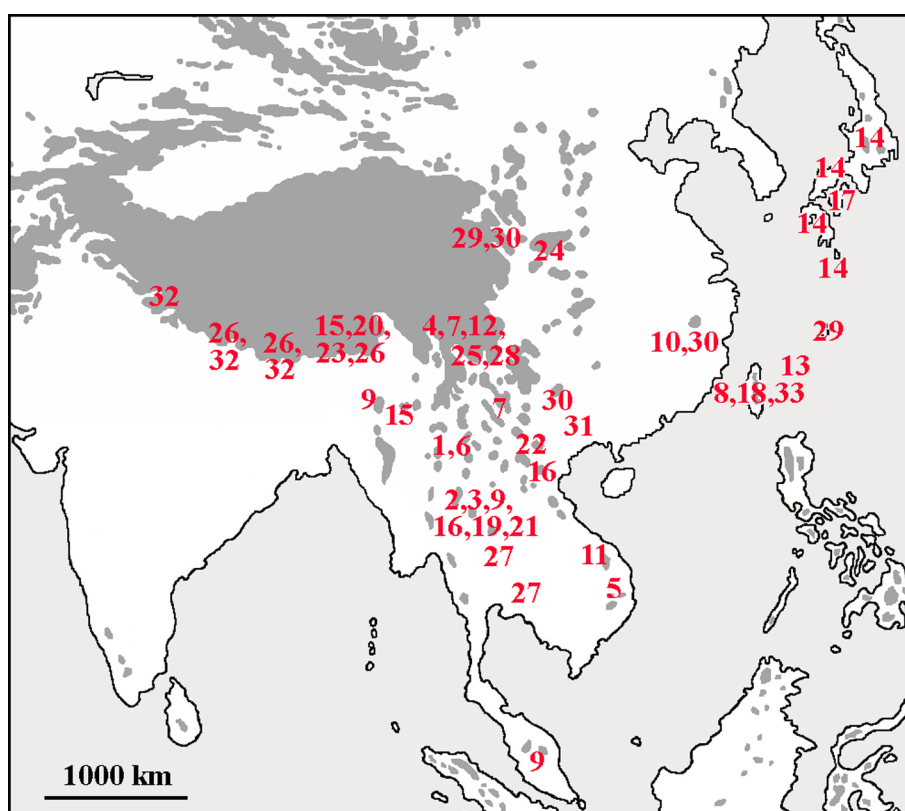
**FIGURES 36–39.** *Cryptoperla teana* Li & Murányi, **sp. n.**, habitats and larval habitus—36: seep at Golden Turtle Waterfall, locality of the holotype; 37: inflow stream above Dragon Lake, paratype locality; 38: alive pharate female larva at Golden Turtle Waterfall; 39: last instar but not matured larva from Dragon Lake, preserved in ethanol.

**Distribution and ecology.** The new species was found at two water flows within Damingshan National Natural Reserve, Guangxi Zhuang Autonomous Region. The Daming Mountains form relatively isolated range in central Guangxi, and the *Cryptoperla* was found on high plateau of the range. Lentic and lotic waters distinctively 'tea-colored' because of high humin acid content occurred. The two mature larvae were found under stones in a vertical rocky seep close to a pond beneath Golden Turtle Waterfall (Fig. 36), while penultimate instar larvae were numerous under littoral stones at rapid section of a stream flowing into Dragon Lake (Fig. 37). The matured larvae are both emerged safely within a few days; however, we were not able to rear the penultimate instar larvae from the Dragon Lake stream. March should be considered as beginning of the emergence period of the species. It is worth to note that penultimate instar larvae were able not only to run fast but to jump up to ten centimeters in distance. No mature eggs were found in the female adult despite being alive for more than two weeks. At the seep, the holotype



and paratype were found together with numerous *Indonemoura* Baumann, 1975 larvae but no other stoneflies. The stream inhabited by the paratype larvae are shared with a few other Leuctridae, Nemouridae and Perlidae, including a new *Rhopalopssole* Klapálek, 1912 species (Li *et al.* 2017a).

**Affinities.** The female is difficult to identify, but combination of a broadly rounded subgenital plate, shape of metathoracal postscutellar process and general coloration distinguish it from most known congeners. The arrangement of setae of the male cerci is most similar to the Himalayan *C. pentagonalis* Zwick & Sivec, 1980 and less to Central Chinese *C. nangongshana* Huo & Du, 2018, but their figures (fig. 10, Huo & Du 2018) of the everted aedeagi appear differ by more complex lobes and surface structures. No similar cerci or aedeagus were found after comparison with other Asian species (aedeagus of some Chinese species still unknown, e.g. even the lately described *C. dactylina* Du, 2018 (in: Huo & Du 2018)). The larva also appears similar to the *C. pentagonalis* by configuration of ventral fringes of thorax and dense blade-like setae of the cerci, but easy to distinguish on the basis of distinct color pattern.



**FIGURE 40.** Known distribution of the *Cryptoperla* species—1: *C. aculeata* Wu, 1973); 2: *C. akha* Stark, 1989; 3: *C. bisaeta* (Kawai, 1968a); 4: *C. chiangi* (Banks, 1940); 5: *C. curvata* Stark & Sivec, 2007a; 6: *C. dactylina* Du, 2018; 7: *C. dui* Sivec, 2005; 8: *C. formosana* (Okamoto, 1912); 9: *C. fraterna* (Banks, 1938); 10: *C. fujianica* Sivec, 1995; 11: *C. hubleyi* Stark & Sivec, 2007a; 12: *C. spec. Ch A sensu* Stark & Sivec, 2007a; 13: *C. ishigakiensis* (Kawai, 1968b); 14: *C. japonica* (Okamoto, 1912); 15: *C. kali* Stark, 1989; 16: *C. karen* Stark, 1989; 17: *C. kawasawai* Maruyama, 2002; 18: *C. klapaleki* Stark & Sivec, 2007b; 19: *C. kosai* Stark & Sivec, 2007a; 20: *C. kumari* Stark, 1989; 21: *C. meo* Stark, 1989; 22: *C. meyi* Stark & Sivec, 2007a; 23: *C. naga* Stark, 1989; 24: *C. nangongshana* Huo & Du, 2018; 25: *C. obtusa* (Wu, 1973); 26: *C. pentagonalis* Zwick & Sivec, 1980; 27: *C. simplex* Stark & Sivec, 2007a; 28: *C. sinensis* (Wu & Claassen, 1934); 29: *C. spp.*, unidentified; 30: *C. stilifera* Sivec, 1995; 31: *C. teana* **sp. n.**; 32: *C. torva* Needham, 1909; 33: *C. uchidai* Stark & Sivec, 2007b—grey areas are above 2000 meters.

**Etymology.** The name *teana* (from the Latin word *teanus*, meaning 'of tea') refers to the habitat of the species, tea-colored waters of the Damingshan plateau. Used as a possessive pronoun, gender feminine.

**Known distribution of the *Cryptoperla* species** (Fig. 40). The genus *Cryptoperla* is distributed mainly in the eastern continental areas of the Oriental Region and enters the East Palearctic on the Japanese Archipelago. No *Cryptoperla* species are known from the Indian Subcontinent outside of the Himalayas, neither from the Southeast Asian islands. The type species, *C. torva* Needham, 1909 and its type locality constitutes the westernmost occurrence, in Himachal Pradesh state of India. *Cryptoperla torva* and *C. pentagonalis* Zwick & Sivec, 1980 seem



to be widespread in most of the Himalayas, whereas the further three species were found in the East Himalayas, in Arunachal Pradesh state of India. The Tibetan Plateau and the Indochina Peninsula apparently is the center of species diversity of the genus, with the northernmost continental records known from southern Gansu Province of China (*C. stilifera* Sivec, 1995). The genus apparently dispersed southwards into peninsular Malaysia (*C. fraterna* (Banks, 1938)). In the eastern areas of Oriental China, the genus seems to be rare, with only two species known from Fujian Province (*C. fujianica* Sivec, 1995 and *C. stilifera* Sivec, 1995). East of the continent, *Cryptoperla* species occur on Taiwan, larger isles of the Ryukyus, Kyushu, Shikoku and on Honshu up to Nagano Prefecture of Japan.

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