

BRAUERIA (Lunz am See, Austria) 50:11-14 (2023)

New species of *Cheumatopsyche* (Trichoptera: Hydropsychidae) from Sulawesi

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Abstract. Four new caddisfly species of the genus *Cheumatopsyche* WALLENGREN, 1891; *C. garislebar* sp. nov., *C. garistipis* sp. nov., *C. garistenga* sp. nov., and *C. ballo* sp. nov., are described from Sulawesi, Indonesia. Also, *C. lucida* (Ulmer, 1907) is reported as new to Sulawesi.

Keywords: Hydropsychidae, *Cheumatopsyche*, new species, Sulawesi

Introduction

Seven species of *Cheumatopsyche* have been described from Sulawesi, all of them during the last 25 years (MALICKY 1997 and 2009, GERACI & MORSE 2008), while no other species of the genus have been reported from the island. In this study, four additional species are described, and one species is reported as new to Sulawesi.

Like in most caddisflies, male genital morphology is the fundamental basis for the species-level taxonomy (MALICKY 2010) and has also been used as a basis to define species groups within the genus (OLÁH et al. 2008). Females tend to remain unidentifiable to species level due to their simplified and soft genital structures which are almost unchanged from one species to another. Most *Cheumatopsyche* also look rather similar in the wings typically having only faint shadows or mottling on the yellowish brown or grey bottom. However, some species have striking fore wing colour patterns, which may also help in the practical identification work, including females.

Material and methods

All specimens were sampled by Marko Jaakkola in South and Central Sulawesi in 2019–2020. The method was to use a single battery operating, custom-built 8W LED system, with 365 nm, 450 nm, 530 nm and white coloured LEDs. The specimens were stored dry for transport, and in 80% alcohol in the laboratory. The male abdomens of the holotypes and paratypes were cleared in 10% NaOH. The genital structures were drawn from the holotypes by Hans Malicky and digitized by Juha Salokannel. The wing patterns were drawn by Juha Salokannel with the aid of orthogonal wing photos. All the holotypes and some paratypes are deposited in the research collection of Hans Malicky in Lunz Am See, Austria. Some paratypes are deposited in the Finnish Museum of Natural History (FMNH) in Helsinki, Finland. FMNH codes are appended for those specimens. The morphological terminology in the descriptions follows OLÁH et al. (2008).

New species

Cheumatopsyche garislebar SALOKANNEL, JAAKKOLA & MALICKY sp. nov.

Diagnosis: This species may be considered as part of the *C. costalis* species group according to OLÁH et al. (2008) due to the short apicoventral lobes of segment IX. However, the combination of the smooth mesocaudal lobe of segment X in dorsal/ventral view and the shape of the harpago is unique. Also, the fore wing pattern seems specific: *C. garistipis* sp. nov. and *C. garistenga* sp. nov. described in this paper are closely related, but the whitish stripes of *garislebar* sp. nov. type specimens are

wider and the extended spot in the hind corner is missing from the two others.

Description: Head and body dark brown. Forewing length: holotype male 7.0 mm, paratype female 7.5 mm. Fore wings dark brown with whitish transverse pattern; three relatively wide, solid stripes at the base and central parts; two extended, but unconnected spots at the distal third. Male genitalia: Segment IX in lateral view anteriorly bow-shaped, the apical lobe blunt. Segment X dorsally slightly concave, mesocaudal lobe pointed somewhat upwards in lateral view; apicoventral lobes short, basally constricted, mesocaudal lobe slightly convex in dorsal/ventral view. Harpago basally as wide as the tip of the coxopodite in lateral view, slightly constricted before the blunt tip in ventral view. Phallosome dorsum smoothly concave, endothecal process round in lateral view. Phallosome sclerites oval in lateral view, forming two rounded patches between the endothecal processes in ventral view.

Holotype: INDONESIA, South Sulawesi, Puri Rimba, 2°57'32.2"S, 120°05'11.9"E, alt. 781 meters, 1st Feb. 2020. **Specimen code:** SULA-T471-1. **Paratype:** a female from the same collection, specimen code: JSLK-SULA-T471-2, FMNH reference: <http://id.luomus.fi/GZ.52999>. The female was associated with the male due to the similar fore wing markings and the same collecting time and place.

Etymology: The name refers to the relatively wide stripes of the fore wings in the Indonesian language.

Cheumatopsyche garistipis SALOKANNEL, JAAKKOLA & MALICKY sp. nov.

Diagnosis: This species may be considered as part of the *C. costalis* species group according to OLÁH et al. (2008) due to the short apicoventral lobes of segment IX. The combination of the high intersegmental step between segments IX and X, toothed harpago, and the distal part of the phallus is unique. Also, the fore wing pattern seems specific: *C. garislebar* sp. nov. and *C. garistenga* sp. nov. described in this paper are rather similar, but *garistipis* sp. nov. has narrower central stripes, the outer of which is widely interrupted. The pattern in the distal third is limited to a narrow stripe connected to the front edge, closer to the fore wing apex than in the two other species.

Description: Head and body dark brown. Forewing length: 6.2 mm. Fore wings dark brown with whitish transverse pattern; a basal stripe or spot, two narrow stripes in the central part, the outer of which widely interrupted, a narrow stripe connected to the front edge close to the apex.

Male genitalia: Segment IX in lateral view anteriorly bow-shaped, the apical lobe strongly convex. The intersegmental depression between segment IX and X on the dorsal side almost as high as segment X. Segment X blunt in lateral view; apicoventral lobes short, laterobasally slightly constricted, mesocaudal edge straight in dorsal/ventral view. Harpago short and broad, tapering from basal third towards the tip in ventral view; a tooth-like protrusion in the middle of dorsum. Phallosome dorsum slightly concave, endothecal process oval. Phallosome sclerite forming pointed patches between the endothecal process in ventral view.

Holotype: INDONESIA, South Sulawesi, Gereja Toraja Tapparan, 3°02'01.9"S, 119°48'02.3"E, alt. 791 meters, 23rd Jan. 2020. **Specimen code:** JSLK-SULA-T260.

Etymology: The name refers to the narrow stripes of the fore wings in the Indonesian language.

Cheumatopsyche garistenga SALOKANNEL, JAAKKOLA & MALICKY sp. nov.

Diagnosis: This species may be considered as part of the *C. costalis* species group according to Oláh et al. (2008) due to the short apicoventral lobes of segment IX. The combination of the smooth mesocaudal lobe of segment X in dorsal/ventral view and the shape of harpago, as well as the distal part of the phallus are unique. Also, the fore wing pattern seems specific: *C. garislebar* sp. nov. and *C. garistipis* sp. nov. described in this paper are closely related, but *C. garistenga* sp. nov. has an additional whitish spot at the hind edge between the basal and the inner central stripe, and in addition to the whitish frontal spot there are several faint grey spots in the distal third.

Description: Head and body dark brown. Forewing length: males 5,6 – 5,8 mm, females 4,8 – 5,7 mm. Fore wings dark brown with transverse whitish pattern; a wide basal stripe, two continuous stripes in the central part; a small spot between the basal stripe and inner central stripe at the hind edge; a frontal spot in the distal third; a group of faint grey spots next to the frontal spot.

Male genitalia: Segment IX in lateral view anteriorly bow-shaped, the apical lobe strongly convex. Segment X dorsally slightly concave, mesocaudal lobe barely elevated in lateral view; apicoventral lobes short, slightly laterobasally constricted, mesocaudal lobe very slightly convex in dorsal/ventral view. Harpago narrow, about half of the width of the distal part of coxopodite, apically curved shortly dorsad. Phallosome dorsum straight, endothelial process round, basally elongated in lateral view. Phallosomal sclerite triangular, pointed in lateral view, forming triangular patches between the endothelial process in ventral view.

Holotype: INDONESIA, Central Sulawesi, Banggai regency, Luwuk, Hanga-Hanga, Piala waterfalls, 0°57'04.1"S, 122°46'13.7"E, alt. 461 meters, 7th Feb. 2020. Specimen code: JSLK-SULA-T373. **Paratypes:** Four specimens from the same collection site and time as the holotype, 1) specimen code: JSLK-SULA-T374-1, coll. Malicky (male), 2) specimen code: JSLK-SULA-T374-2, FMNH reference: <http://id.luomus.fi/GZ.52300> (male), 3) specimen code: JSLK-SULA-T374-3, FMNH reference: <http://id.luomus.fi/GZ.52301> (female), and 4) JSLK-SULA-T374-4 FMNH reference: <http://id.luomus.fi/GZ.52302> (female). The females were associated with the males due to the similar fore wing markings and the same collecting time and place.

Etymology: The name refers to the mid-wide stripes of the fore wings, compared with *C. garistipis* sp. nov. and *C. garislebar* sp. nov. in the Indonesian language. Also, the holotype's locality is in Central (tenga) Sulawesi.

Cheumatopsyche ballo Salokannel, Jaakkola & Malicky sp. nov.

Diagnosis: This species may be considered as part of the *C. costalis* species group according to Oláh et al. (2008) due to the short apicoventral lobes of segment IX. The combination of smooth mesocaudal lobe of segment X in dorsal/ventral view and the shape of harpago is unique. Sulawesi species *C. tenga* Geraci, 2008 seems closely related, but *C. ballo* sp. nov. has narrower apicoventral lobes and more rounded mesocaudal lobe of segment X in ventral/dorsal view and basally wider harpago in lateral view.

Description: Head, body and appendages light yellowish. Forewing length: 5,3 - 6,5 mm. Fore wings cream light yellowish brown with faint mottling.

Male genitalia: Segment IX in lateral view anteriorly bow-shaped, the apical lobe rounded right-angled. The intersegmental depression between segment IX and X steep. Segment X dorsally flat, mesocaudal lobe pointed upwards in lateral view; apicoventral lobes short and narrow, mesocaudal lobe slightly convex in dorsal/ventral view. Harpago very narrow, slightly bent in ventral view; apically curved dorsad. Phallosome dorsum straight, endothelial process round in lateral view. Phallosomal sclerite forming pointed patches between the endothelial process in ventral view.

Holotype: INDONESIA, South Sulawesi, Palopo city (2 km NW) 2°58'54.3"S, 120°09'39.3"E, alt. 98 meters, 20th Dec. 2019. Specimen code: JSLK-SULA-T160-2. **Paratypes:** 3 males from the same collection 1) specimen code: JSLK-SULA-T160-3, FMNH reference: <http://id.luomus.fi/GZ.52996>, 2) specimen code: JSLK-SULA-T160-4, FMNH reference: <http://id.luomus.fi/GZ.52997>, 3) specimen code: JSLK-SULA-T160-5, FMNH reference: <http://id.luomus.fi/GZ.52998>.

Etymology: The name refers to the colour of the fore wings, being comparable to the colour of the local palm sap-based beverages.

New records

Cheumatopsyche lucida (ULMER, 1907)

New to Sulawesi. Records: INDONESIA, South Sulawesi, Mandetok, Sadang River 3°03'41.1"S, 119°52'05.3"E, alt. 765 m. 26th Feb. 2019. Specimen code: JSLK-SULA-T037 (1 male) and INDONESIA, South Sulawesi, Palopo city (2 km NW) 2°58'54.3"S, 120°09'39.3"E, alt. 98 m., 20th Dec. 2019. Specimen code: JSLK-SULA-T161 (1 male).

Discussion

The three new *Cheumatopsyche* species with dark brown wings, transverse whitish stripes were found in "mid-high" altitudes between 450 and 800 meters in South and Central Sulawesi. Each habitat was a stony, fast running clear water brook or small river, including various size of falls. These species are likely endemic to Sulawesi, but how local – and vulnerable – they are within Sulawesi is too early to estimate. The light-coloured *C. ballo* sp. nov. was so far recorded from a lower altitude (98 m) site only. *C. lucida*, a wide-spread Southeast Asian species, was recorded at both a low (98 m) and mid-high (765 m) altitudes.

The three stripe-winged new species appear to be identifiable using their wing patterns, including the females. However, this is to be verified with further studies on possible variations and remaining unknown species. Interestingly, *C. garistipis* sp. nov. has clearly different shape of segment X and harpago compared with the two other stripe-winged species. It is not clear how to group those stripe-winged species off from the light-winged species using the genital morphology.

Acknowledgements

We thank the Gabungan Kelombok Tani Hutan Tandung Billa park's representative Mr. M Nur Aras Sandi (Indonesia) for the diverse local practicalities he handled making this study possible. Mr. Wilanda Lande (Indonesia) provided the accommodation during the Tana Torajan area stay.

Dr. Heidi Viljanen (Finland) stored and documented the paratype specimens in the collection of the Finnish Museum of Natural History. Timo Kämäräinen (Finland) and Markus P. Rantala (Finland) provided the LED light catching equipment.

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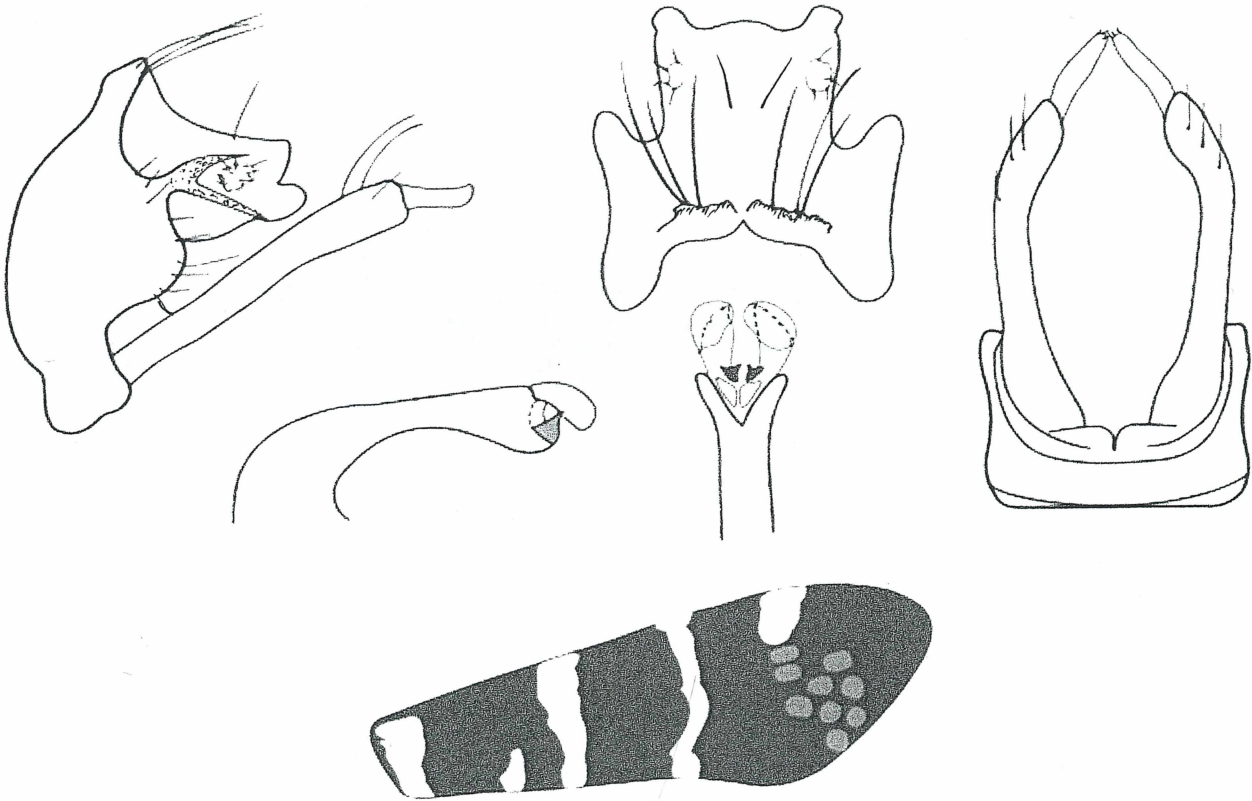
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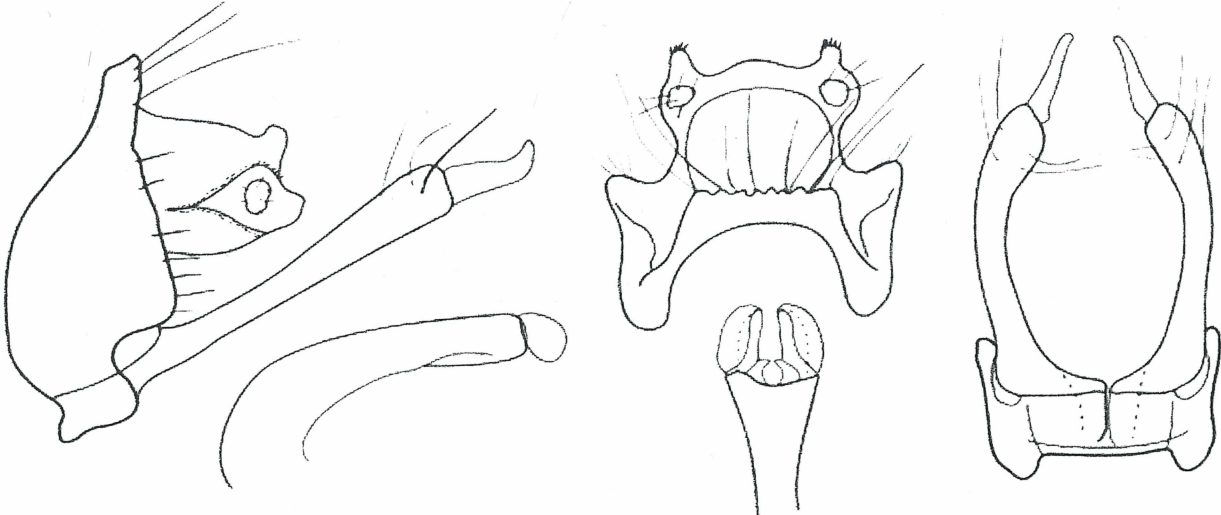
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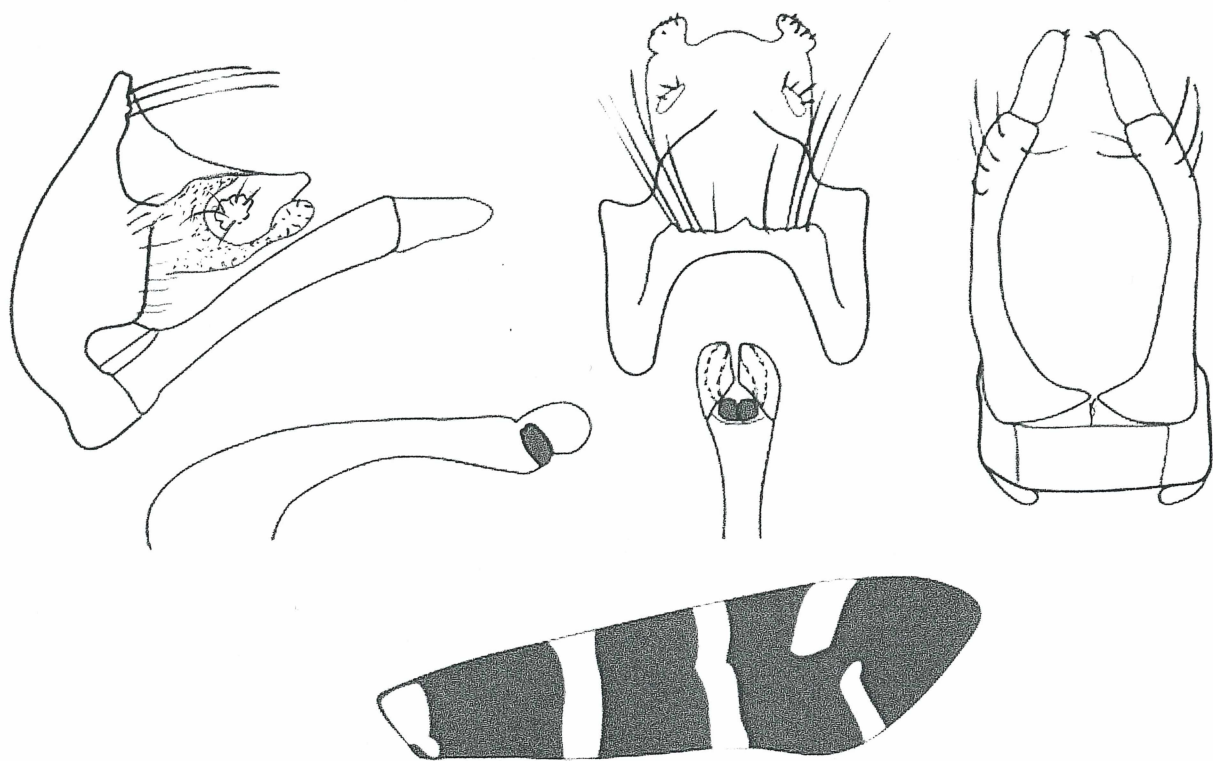
Cheumatopsyche garistenga



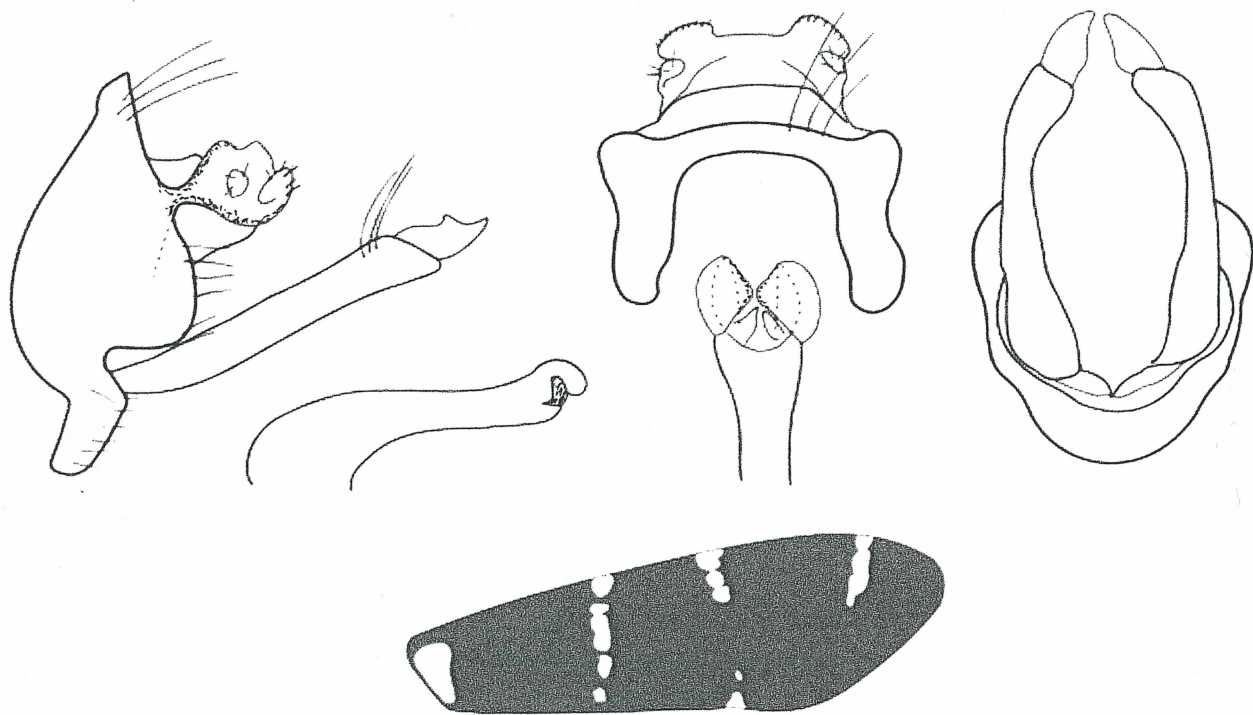
Cheumatopsyche ballo



Cheumatopsyche garislebar



Cheumatopsyche garistipis



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Autor(en)/Author(s): Salokannel Juha, Jaakkola Marko, Malicky Hans

Artikel/Article: [New species of Cheumatopsyche \(Trichoptera: Hydropsychidae\) from Sulawesi 11-14](#)