Description of a new species of *Heterocypris* Claus, 1892 (Crustacea: Ostracoda: Cyprididae) from Thailand

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**Abstract.** *Heterocypris sarakahamensis*, new species, is described from a temporary pond in Maha Sarakham Province in the Northeastern part of Thailand. The new species resembles *Heterocypris indica* (Battish, 1981). The following are the main indicative features of the new species: the subelliptical carapace in dorsal view without anterior compression, posterior half of the right valve dorsal margin with inward arch resulting in a thick margin aspect, the evenly arch dorsal margin of the left valve without angulated corner, the serrated bristles on the third endite of the maxillula, the short d1 seta on the second thoracopod, and the long Ga claw of the caudal ramus. *Heterocypris sarakahamensis*, new species, is the first record of the identified *Heterocypris* species in Thailand and it is the third *Heterocypris* species in Southeast Asia.

**Key words.** Cyprinotinae, crustacean, taxonomy, diversity, Southeast Asia

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**INTRODUCTION**

The genera *Heterocypris* and *Cyprinotus* in the subfamily Cyprinotinae Bronshtein, 1947, are close confamiliers as they share several taxonomic features, such as the left valve overlapping the right valve, and the presence of tubercles on the right valve margin. The prime distinguishing character between these two genera is the occurrence of dorsal hump (absent in *Heterocypris*, present in *Cyprinotus*). After this aspect was applied, the taxonomic allocation occurred. Many taxa were originally placed in *Cyprinotus* and subsequently allocated to *Heterocypris*, for example, *Heterocypris aurea* (Sars, 1895), *Heterocypris barbara* (Gauthier & Brehm, 1928), *Heterocypris indica* (Battish, 1981), and *Heterocypris setoensis* (Okubo, 1990). However, many taxa are still kept in an uncertain group (see Karanovic, 2012; Martens et al., 2019) due to insufficient descriptions and the unclear occurrence (presence or absence) of the dorsal hump.

The genus *Heterocypris* Claus, 1892, is the most diverse genus in the Cyprinotinae. Martens & Savatenalinton (2011) listed 63 species in the genus, 58 of which were included in a 62-species list of *Heterocypris* provided by Karanovic (2012). There are 12 species encountered in the Oriental region, including eight endemic species of the region. In Southeast Asia, two *Heterocypris* species were recorded from the Philippines: *Heterocypris congenera* (Vávra, 1897) and *H. favosa* Victor & Fernando, 1980 (see Tressler, 1937). In Thailand, an unidentified *Heterocypris* was mentioned in the Thai ostracod checklist by Savatenalinton & Suttajit (2016). These specimens were examined and revealed as a new species. Thus, it is described in the present contribution, together with a discussion on the morphological comparison with related taxa.

**MATERIAL AND METHODS**

Samples were collected with a hand net (mesh size 200 µm) and immediately preserved in 70% ethanol. In the laboratory, specimens were sorted, and soft parts and valves were separated under an Olympus SZ-PT stereo-microscope. Soft parts were dissected in glycerine and then sealed on glass slides while valves were stored dry on micropalaeontological slides. Drawings of soft parts were made with the aid of a camera lucida. Carapaces and valves were observed and illustrated using a Scanning Electron Microscopy (JEOL JSM6460LV – at the Faculty of Science, Mahasarakham University, Maha Sarakham, Thailand). The chaetotaxy of the limbs proposed by Broodbakker & Danielopol (1982) is followed, together with the models for the antenna revised by Martens (1987) and for the thoracopods revised by Meisch (2000). All type material of new species are deposited in the Science Faculty Museum, Mahasarakham University, Maha Sarakham, Thailand (MSU).

**Abbreviations used in text and figures.** MSU-ZOC, Ostracod Collection of the Science Faculty Museum, Mahasarakham University, Maha Sarakham, Thailand; Cp, carapace; H, height of valves; L, length of valves; LV, left valve; RV, right valve; W, width of carapace; A1, first antenna; A2, second antenna; Md, mandibular; Mx1,
maxillula; T1, first thoracopod (maxilliped); T2, second thoracopod (walking leg); T3, third thoracopod (cleaning leg); CR, caudal ramus.

**TAXONOMY**

**Family Cyprididae Baird, 1845**

**Subfamily Cyprinotinae Bronshtein, 1947**

**Heterocypris Claus, 1892**

**Heterocypris sarakhamensis**, new species

(Figs. 1–6)

*Heterocypris sp.* – Savatenalinton & Suttajit, 2016: 9, table 2.

**Material examined.** Holotype: Male, soft parts dissected in glycerine on a sealed slide, valves stored dry on a micropalaeontological slide (MSU-ZOC.246), a temporary pond, Maha Sarakham Province, Thailand, 16°14′54″N 103°15′21″E, coll. S Savatenalinton, 24 September 2005.

Allotypes: 1 female, stored like the holotype (MSU-ZOC.247), same data as holotype.

Paratypes: 2 dissected males (MSU-ZOC.248–249) stored like the holotype, 2 undissected males (MSU-ZOC.250–251) stored dry on micropalaeontological slides, 2 dissected females (MSU-ZOC.252–253) stored like the holotype, 3 undissected females (MSU-ZOC.254–256) stored dry on a micropalaeontological slide, c. 10 males and 20 females in 70% ethanol, same data as holotype.


Fig. 1. *Heterocypris sarakhamensis*, new species. A–C, F, female; D–E, male. A, Cp, dorsal view; B, Cp, right lateral view; C, Cp, left lateral view; D, Cp, dorsal view; E, Cp, right lateral view; F, valve surface of Cp, left lateral view. Scale bar: A–E = 200 μm, F = 10 μm.
Carapace in lateral view subovate, LV overlapping RV all free margins, anterior and posterior ends subequally rounded. Carapace in dorsal view subelliptical, anterior end narrowly rounded without compression, posterior end more rounded. RV in internal view with tuberculated margin antero-ventrally (27–32 tubercules), postero-ventrally (25–30 tubercules); posterior half of dorsal margin arching inwardly representing thick appearance. LV in internal view with broad border at postero-ventral part, posterior margins rounded (not angulated). Valve surface with shallow pits and setae dispersedly. A2 with long natatory setae. Both bristles on third endite of Mx1 serrated. a, b, d-setae on T1 present. T2 without d2 seta, d1 seta short. T3 with pincer organ at terminal end, f-seta long (reaching end of terminal segment). CR with long Ga claw, length of ramus 1.65 times that of Ga claw.

Description of female. Carapace in lateral view (Fig. 1B, C). Subovate, anterior and posterior margins subequally rounded, LV overlapping RV anteriorly, ventrally and posteriorly, dorsal margin strongly arched, greatest height situated at mid-length, ventral margin straight, valve surface with very shallow pits (almost smooth) and thin setae scattering (Fig. 1F).

Carapace in dorsal view (Fig. 1A). Subelliptical, with greatest width situated at mid-length, LV overlapping RV anteriorly and posteriorly, anterior and posterior ends rounded, posterior more rounded.

LV in internal view (Fig. 2A, C, D). Subovate, anterior margin rounded, posterior margin rounded (not angulated) with broad border at postero-ventral part, complementary sockets present at antero-ventral and postero-ventral margins, dorsal margin distinctly arched, greatest height situated slightly before mid-length, ventral margin somewhat straight; calcified inner lamella relatively wide anteriorly and posteriorly, without inner list.

RV in internal view (Fig. 2B, E, F). Subovate, anterior and posterior margins subequally rounded (posterior slightly more rounded), tubercules present at antero-ventral (27–32 tubercules) and postero-ventral (25–30 tubercules) margins, dorsal margin distinctly arched with posterior half margin arching inwardly representing thick appearance, greatest height situated c. mid-length, ventral margin slightly situated at mid-length; calcified inner lamella relatively wide anteriorly and posteriorly, without inner list.

A1 (Fig. 3A). First segment with small proximal Wouters organ, one subapical dorsal seta of long length (reaching half of next segment) and two long apical ventral setae. Second segment slightly wider than long, with one short apical dorsal seta (not reaching mid-length of next segment) and small Rome organ. Third segment bearing two subequally long setae (one apical dorsal seta, one apical ventral seta), reaching beyond tip of fourth segment. Fourth segment with two long dorsal setae and two subequal, shorter ventral setae (both reaching slightly beyond tip of terminal segment).

Fifth segment dorsally with two long setae, ventrally with two (one long, one shorter) setae, shorter one reaching far beyond tip of terminal segment. Penultimate segment with four long and one shorter setae, shorter one reaching beyond tip of terminal segment. Terminal segment with three (two long, one short) apical setae and aesthetasc Ya, the latter c. half of short apical seta.

A2 (Fig. 3B). Exopod with three (one long, two short) setae, long one reaching tip of first endopodal segment. First endopodal segment with five long (reaching beyond tip of terminal claws) and one short natatory setae, length of shortest seta not reaching tip of penultimate segment (length c. ⅓ that of penultimate segment), aesthetasc Y slim, short (c. ⅓ of length of segment), apical ventral seta long, reaching slightly beyond tip of terminal segment. Penultimate segment undivided, distally with three serrated claws (G1–G3), G2 shortest claw (length c. ⅔ that of G1 claw), aesthetasc y2 short (less than half of terminal segment), z1–z3 setae long; this segment medially with two (one long, one shorter) dorsal setae (length of short one c. ⅓ that of long one) and four ventral setae of unequal length (t1–t4). Terminal segment with two serrated claws (GM and Gm), g-seta and aesthetasc y3, length of Gm slightly more than half of that of GM, g-seta short (slightly beyond accompanying seta of aesthetasc y3), length of aesthetasc y3 c. ⅔ that of accompanying seta.

Md-palp (Fig. 3C, D). First segment with two large setae (s1 and s2), one slender, long seta and short a-seta, the latter smooth and slim. Second segment dorsally with three unequal long apical setae, length of shortest c. ⅔ that of longest; ventrally with a group of three long hirsute setae, one shorter hirsute seta and b-seta, the latter slim and plumose. Penultimate segment consisting of three groups of setae: dorsally with a group of four unequally long, subapical setae; laterally with apical γ-seta and three further smooth apical setae, γ-seta short, stout, hirsute (tip slightly beyond end of terminal segment); ventrally with two (one long, one very short) apical setae, short one not reaching mid-length of terminal segment. Terminal segment bearing three claws and three setae. Md-coxa (Fig. 4A) elongated, with c. 16 blunt teeth.

Mx1 (Fig. 4B) with two-segmented palp, three endites, and a large branchial plate; basal segment of palp with group of five long, unequal apical setae and two (one long, one short) subapical setae, short one not reaching tip of terminal segment (c. ¼ of terminal segment), terminal segment elongated (length c. two times width), apically with three claws and three setae. Two large bristles on third endite serrated. Sideways-directed bristles on first endite unequally long, length of short one c. ⅔ that of long one.

T1 (Fig. 4C) protopod with two short a-setae, long b (c. four times the length of a-setae) and d-setae, b seta shorter (c. ⅔) than d seta, distally with 14 (10 apical, four subapical) hirsute setae of unequal length. Endopod weakly built palp with three unequal apical setae, length of shortest one c. half of longest one.
Fig. 2. *Heterocypris sarakhamensis*, new species. A–F, female; G–H, male. A, LV, internal view; B, RV, internal view; C, posterior part of LV, internal view; D, anterior part of LV, internal view; E, anterior part of RV, internal view; F, posterior part of RV, internal view; G, LV, internal view; H, RV, internal view. Scale bar: A, B, G, H = 200 µm, C–F = 100 µm.
Fig. 3. *Heterocypris sarakhamensis*, new species, female. A, A1; B, A2; C, Md-palp; D, terminal segment of Md-palp. Scale bar = 100 µm.
Fig. 4. *Heterocypris sarakhamensis*, new species, female. A, Md-coxa; B, Mx1; C, T1; D, T2. Scale bar = 100 µm.
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**T2** (Fig. 4D) 5-segmented. Protopod with short d1 seta, d2 seta absent. First endopod segment with short e-seta (reaching mid-length of penultimate segment). Penultimate segment divided into two segments: a and b segments, a-segment bearing long f-seta (reaching tip of terminal segment), b-segment with a pair of apical setae (long g-seta and one short seta), short one c. ⅓ of g-seta. Terminal segment with two (one dorsally, one ventrally) long apical h1 and h3 setae and a serrated claw (h2), length of h3 c. ⅓ of that of h2.

**T3** (Fig. 5A) cleaning limb. First segment with long d1, d2, dp setae. Second segment with long apical e-seta (reaching tip of next segment). Third segment with medially long f-seta (reaching tip of segment). Terminal segment with apical pincer (h2), one short h1 seta, and one reflexed subapical h3 seta, length of the latter c. ⅔ of that of third segment.

Caudal ramus (Fig. 5B) well-developed, length of claw Ga c. half of that of ramus, length of claw Gp c. ⅔ that of claw Ga. Sa seta thin, short (c. half of claw Ga), slightly hirsute, Sp seta thin, long (reaching half of claw Gp). Caudal ramus attachment (Fig. 5C) long, slender, dorsal branch reduced, ventral branch slim, with pointed end.

**Description of male.** Carapace and valves (Figs. 1D, E, 2G, H) as in female, but somewhat smaller. All limbs as in female, except for last two segments of A2 (Fig. 5A, B) and T1 (Fig. 5C, D).

Setae z1 and z2 of penultimate segment of A2 transformed into claws; claw G1 reduced, appearing smaller and shorter; claw G3 reduced to seta, length of claw G1 slightly less than half of claw G2; length of G3 almost same length of claw G1; Gm on terminal segment of A2 reduced, appearing smaller and shorter (length beyond half of that of GM).

T1 with asymmetrical prehensile palps (endopodites). Left prehensile palp (Fig. 5C) with first segment bearing two short apical spines; second segment narrow, curved and pointed. Right prehensile palp (Fig. 5D) with first segment bearing two long apical spines; second segment large, subtriangular.

Hemipenis (Fig. 5E). Medial shield large, subtriangular with blunt end, lateral shield elongated, curved apically with pointed end, internal postlabyrinthal spermiduct with one loop. Zenker organ (Fig. 5F) elongated, length c. 5.3 times width, set with many chitinous spiny whirls.

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Fig. 5. *Heterocypris sarakhamensis*, new species, female. A, T3; B, CR; C, CR attachment. Scale bar = 100 µm.
Etymology. The species is named after Maha Sarakham Province, which is also, in short, called “Sarakham”, where the new species was discovered.

Distribution and ecology. *Heterocypris sarakhamensis*, new species, is a rare species. It was found in only one locality, a pond in Mahasarakham University, Maha Sarakham Province, Thailand. This pond was densely covered with aquatic plants, most of them water hyacinth. It is dried occasionally.

DISCUSSION

*Heterocypris* and *Cyprinotus* are morphologically close genera as they have the same pattern of valve overlap, LV overlapping RV, and the presence of the tuberculated margin RV. Although these two genera belong to different lineages based on molecular analysis (Yoo et al., 2017), there are very limited indicative morphological differences; the most obvious discriminating character is only the presence or
absence of dorsal hump on the RV (present in Cyprinotus, absent in Heterocypris; see Meisch, 2000; Karanovic, 2012; Martens et al., 2019). Furthermore, the valve morphology of Heterocypris sensu stricto, such as H. incongruens, H. replans, and H. barbarra (see Brady, 1886; Martens, 1996; Meisch, 2000), are not identical with those of species like H. indica and H. sarakhamensis, new species. This may indicate that Heterocypris is probably not a monophyletic group. The polyphyly of Heterocypris was also suggested by Yoo et al. (2017) and Halse & Martens (2019). It is obviously necessary to conduct more comprehensive study on the systematics of these genera, but the present study tentatively emphasises the morphology of dorsal hump-like structure to decide the generic position of Heterocypris and Cyprinotus species.

Sixty-three species of Heterocypris have been recorded worldwide (Martens & Savatenalinton, 2011), while there are 18 species reported from the Oriental region, nine of which are endemic to the region (Meisch et al., 2019). Heterocypris sarakhamensis, new species, described here is the first record of the identified Heterocypris species in Thailand and the third species of Heterocypris in Southeast Asia, after H. congnera and H. favosasa (see Tressler, 1937). The Thai new species differs from two Southeast Asian Heterocypris species mainly by the presence of the dorsal hump-like structure on the RV. In addition, H. sarakhamensis, new species, can be clearly distinguished from H. favosasa by the long Sa setae on the CR (considerably short in H. favosasa). At first glance, H. sarakhamensis, new species, is similar to H. indica (Battish, 1981).

Heterocypris indica was described, based on materials from India, as a member of Cyprinotus (see Battish, 1981), and Martens & Savatenalinton (2011) later transferred the species to Heterocypris. However, Karanovic (2012) suggested that this species should belong to Cyprinotus due to the obvious appearance of the dorsal hump on the RV. Although recent studies placed H. indica in the genus Cyprinotus (see Meisch et al., 2019; Martens et al., 2019), Martens et al. (2019) doubted this arrangement as several features are incongruent to the nature of Cyprinotus. According to the original description and illustrations, the small flange-like structure on the dorsal RV in H. indica (Battish, 1981: fig. 2D) is similar to that of H. sarakhamensis, new species. This structure superficially looks like the dorsal hump of Cyprinotus, but it seems to slightly arch inward and situate on the posterior half of dorsal margin. Such features are somewhat different from the aspects of the actual dorsal hump in Cyprinotus sensu stricto, i.e., it is placed more anteriorly and covers the mid-length of dorsal margin, and the absence of the inwardly-arched feature, for example, C. cingalensis (see Karanovic, 2012; Martens et al., 2019), C. kimberleyensis (see McKenzie, 1966; Martens et al., 2019), C. tenui (see Victor & Fernando, 1981; Smith, 2019), and C. drueba (see Martens et al., 2019). Since H. indica and H. sarakhamensis, new species, are morphologically closer to the condition of Heterocypris, they are here treated as Heterocypris species.

Both H. sarakhamensis, new species, and H. indica have a dorsal hump-like structure, but this feature is relatively smaller in the new species (Fig. 2B, H). Furthermore, the shape of the carapace in lateral view in the new species is more ovate (Fig. 1B, C, E), while it is slightly more elongated in H. indica (Battish, 1981: fig. 2B–D). In H. sarakhamensis, new species, the LV in internal view has small protruding with round margin on the postero-ventral part, a feature missing in H. indica. The valve surface of the new species is equipped with very shallow pits (almost smooth) and scattering setae, whereas the surface is more plumose in H. indica. Also, the chaetotaxy of limbs is different between these two species. The obvious distinguishing features can be noticed in the longer Ga claw, representing more than half-length of the CR in the new species (less than half length in H. indica). In H. sarakhamensis, new species, the length of the shortest natatory setae on the A2 and the e- and f-setae of the T3 are longer than those of H. indica.

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