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## Research article

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# New genus of subfamily Cypridopsinae Kaufmann, 1933 (Crustacea: Ostracoda) from Thailand

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**Abstract.** The new genus *Thaicypridopsis* gen. nov. described here belongs to the tribe Zonocypridini Higuti & Martens, 2012 in the subfamily Cypridopsinae Kaufmann, 1900. It is the first record of the Recent representatives within this tribe in Southeast Asia and Oriental regions. *Thaicypridopsis* gen. nov. has a number of remarkable characters that distinguish it from other genera in the subfamily: a submarginal row of distinctive tubercles on the postero-ventral part of the right valve in the interior view, a strong serrated claw G2 on the second antenna with an apical concavity, large bristles with hirsute endings and spatula-shaped apices on all three maxillular endites and a bifurcate tip on the terminal claw of the second thoracopod. One new species, *Thaicypridopsis longispinosa* sp. nov., is described under this new genus in the present contribution. Apart from the above diagnostic characters, the new species also has long spines on the valve surface as its outstanding feature. The new taxon is morphologically compared with other related species and genera within and outside the subfamily Cypridopsinae. In addition, due to the new genus belonging to a group of genera with the left valve overlapping the right valve in the subfamily, a key to the genera within this group is given.

**Keywords.** Oncocypridinae, microcrustacean, taxonomy, diversity, Southeast Asia.

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## Introduction

Cypridopsinae Kaufmann, 1900 which, is the most diverse subfamily in the family Cyprididae Baird, 1845, is presently composed of 18 genera: *Austrocypridopsis* McKenzie, 1982; *Bryocypris* Røen, 1956; *Cabelodopsis* Higuti & Martens, 2012; *Cavernocypris* Hartmann, 1964; *Cypridopsis* Brady, 1867; *Kapocypridopsis* McKenzie, 1977; *Klieopsis* Martens *et al.* 1991; *Martenscypridopsis* Karanovic, 2000; *Neocypridopsis* Klie, 1940; *Plesiocypridopsis* Rome, 1965; *Potamocypris* Brady, 1870; *Pseudocypridopsis* Karanovic, 1999; *Sarsocypridopsis* McKenzie, 1977; *Siamopsis* Savatentalinton, 2017; *Tanganyikacypridopsis* Martens, 1985; *Thermopsis* Kulköylüoğlu *et al.*, 2003; *Tungocypridopsis* Victor & Fernando, 1983; and *Zonocypris* Müller, 1898 (Martens & Savatentalinton 2011; Higuti & Martens 2012; Savatentalinton 2017). However, the taxonomic position of the genus *Neocypridopsis* is contentious as some authors have placed it in the subfamily Cypridopsinae (e.g., Martens &

Savatenalinton 2011; Higuti & Martens 2012), while others (e.g., Karanovic 2012) have defined it as a genus in the subfamily Oncocypridinae (family Notodromadidae). There are three tribes within the Cypridopsinae: Potamocypridini (Ghetti & McKenzie, 1981), Zonocypridini Higuti & Martens, 2012 and Cypridopsini Kaufmann, 1900 (Higuti & Martens 2012). Only the genus *Potamocypris* belongs to the tribe Potamocypridini and the members of the tribe Zonocypridini are *Cabelodopsis* and *Zonocypris* while the tribe Cypridopsini occupies the largest fraction (the remaining genera). In the Cypridopsinae, six genera are monospecific, four of which are endemic to their specific area. On the contrary, *Cypridopsis* is the dominant group with c. 77 species and is widely distributed in many zoogeographical regions (Martens & Savatenalinton 2011). The original descriptions of many cypridopsine species were incomplete and even questionable in some features, resulting in incorrect morphological comparisons and taxonomic positions. Recently, the reexamination of *Zonocypris hispida* (Sars, 1901) based on new material from Brazil revealed that this species is quite different from other cypridopsine taxa, hence a new genus, *Cabelodopsis*, was erected for it (Higuti & Martens 2012). This is merely an example to show that a revision is needed in the subfamily. In addition, newly surveyed materials from poorly studied areas also harbored taxa, such as the genus *Siamopsis* with five species, which were recently described from Thailand (Savatenalinton 2017). There seems to be no doubt that there is an underestimation of the exact number of species in the Cypridopsinae. Thus far, six cypridopsine species have been recorded in Thailand (Savatenalinton & Suttajit 2016; Savatenalinton, 2017). In the present work, one new genus based on one new species belonging to the tribe Zonocypridini of the subfamily Cypridopsinae is described from Thailand.

## Material and methods

Sample collections were obtained from several types of water body in the central, northern and northeastern parts of Thailand during the period 2005–2011. In total, 293 localities were examined: 3, 54 and 236 localities from the central, northern and northeastern parts, respectively. Samples were taken with a hand net (mesh size 200 µm), preserved in 70% ethanol and later sorted using an Olympus SZ-PT stereo microscope. Soft parts were dissected in glycerine and sealed on glass slides. Valves were stored dry on micropalaeontological slides. Drawings of the soft parts were made with the aid of a *camera lucida*. Carapaces and valves were observed and illustrated using a Scanning Electron Microscope (JEOL JSM6460LV – at the Faculty of Science, Mahasarakham University (MSU)). The chaetotaxy of the limbs follows the model proposed by Broodbakker & Danielopol (1982), revised for the A2 by Martens (1987) and for the thoracopods by Meisch (2000). All type materials of the species were deposited in the Natural History Museum. Non-type material is catalogued by its collection locality and held in the author's personal collection.

## Institutional abbreviations

MSU = Mahasarakham University, Maha Sarakham, Thailand

MSU-ZOC = Ostracod Collection of the Natural History Museum,  
Mahasarakham University, Maha Sarakham, Thailand

## Abbreviations used in material citations

N = Northern part of Thailand  
 NE = Northeastern part of Thailand  
 NE (with numbers) = Ostracod samples collected from southern part of Northeast Thailand  
 NEE = Ostracod samples collected from eastern part of Northeast Thailand  
 NEN = Ostracod samples collected from northern part of Northeast Thailand  
 TH = Ostracod samples collected from Northern Thailand

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**Abbreviations used for valves and carapace**

Cp/CpD	= carapace/carapace in dorsal view
H	= height of valves
L	= length of valves
LV/LVi/LVe	= left valve/left valve internal view/left valve external view
RV/RVi/RVe	= right valve/right valve internal view/right valve external view
W	= width of carapace

**Abbreviations used for limbs**

A1	= first antenna
A2	= second antenna
Md	= mandibula
Mx1	= maxillula
T1	= first thoracopod (maxilliped)
T2	= second thoracopod (walking leg)
T3	= third thoracopod (cleaning leg)
CR	= caudal ramus.

**Results**

Class Ostracoda Latreille, 1802  
Subclass Podocopa G.O. Sars, 1866  
Order Podocopida G.O. Sars, 1866  
Suborder Cypridocopina Jones, 1901  
Superfamily Cypridoidea Baird, 1845  
Family Cyprididae Baird, 1845  
Subfamily Cypridopsinae Kaufmann, 1900  
Tribe Zonocypridini Higuti & Martens, 2012

*Thaicypridopsis* gen. nov.

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**Type species**

*Thaicypridopsis longispinosa* gen. et sp. nov. (here designated).

**Etymology**

The genus is named after the country, Thailand, where the new taxon was discovered. The name is a combination between the abbreviated country name (“Thai”) and the existing generic name “cypridopsis”.

**Diagnosis**

LV overlapping RV. RVi with a row of distinctive submarginal tubercles on postero-ventral part. Valve surface with shallow pitted setae and/or spines. A2 with one strong serrated claw G2. Largest seta on terminal segment of Md-palp apically equipped with hairs. Terminal segment of Mx1-palp cylindrical and elongated, largest setae (bristles) on all three endites with hirsute endings and spatula-shaped apices. Seta d2 on T2 present (d1 absent), terminal claw with bifurcate ending. Terminal segment of T3 with apical pincer. Caudal ramus reduced, flagellum-like with triangular base.

### Differential diagnosis

*Thaicypridopsis* gen. nov. is generally similar to *Zonocypris* and *Cabelodopsis* due to the presence of a strong serrated claw G2 on the A2. It can be distinguished from the other genera of the subfamily Cypridopsinae by the morphology of the RV in the interior view, which appears as a submarginal row of distinctive tubercles on the postero-ventral part, the presence of the robust claw on the terminal segment of the Md-palp, which is apically equipped with hairs, the presence of large bristles with hirsute endings and spatula-shaped apices on the first to the third Mx1 endites and the slightly bifurcated ending of the terminal claw of the T2. These features are diagnostic characters of the new genus and the combination of these aspects has not yet been noted in any other genus of the Cypridopsinae.

### Distribution

Thailand (present study).

### *Thaicypridopsis longispinosa* gen. et sp. nov.

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Figs 1–4

### Etymology

The specific epithet ‘longispinosa’ refers to the outstanding appearance of long spines on valve surface. This is the most prominent character of the new species and can be easily recognized from external morphology.

### Type material

#### Holotype

THAILAND – **Buriram Province (NE)** • ♀ (soft parts dissected in glycerine on a sealed glass slide and valves stored dry on a micropalaeontological slide); Huai Jorakae Mak (reservoir), Muang district; 14°54′41″ N, 103°03′07″ E; 4 Oct. 2010; MSU-ZOC.257.

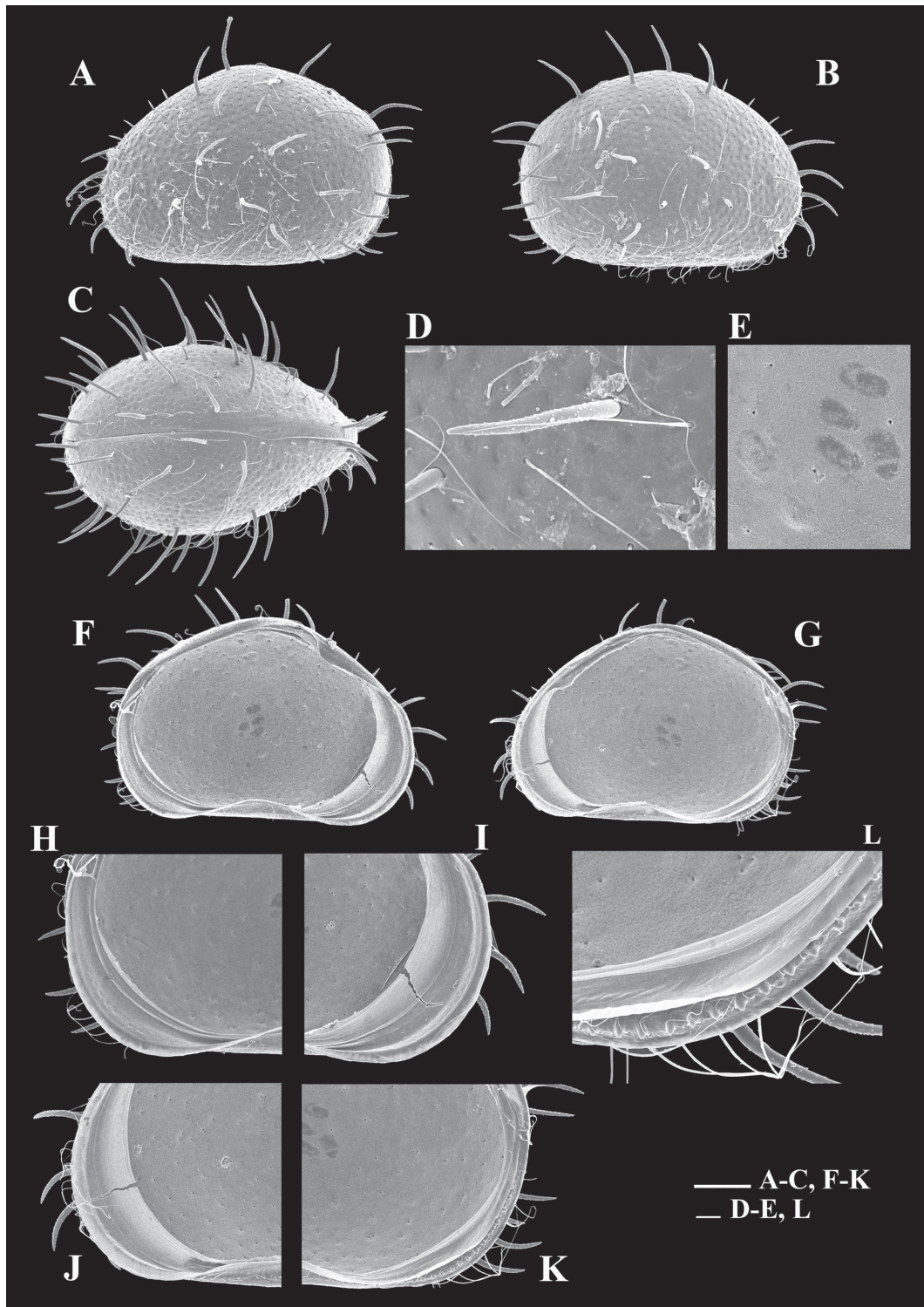
#### Paratypes

THAILAND – **Buriram Province (NE)** • 3 ♀♀ (stored as the holotype); same locality as for holotype; 4 Oct. 2010; MSU-ZOC.258, 261 to 262 • 2 ♀♀ (stored as the holotype); Kwan Phayao (lake); 6 Oct. 2007; MSU-ZOC.263 to 264 • 2 ♀♀ (carapaces stored dry on micropalaeontological slides); same locality as for holotype; 4 Oct. 2007; MSU.ZOC.259 to 260 • 1 ♀ (carapace stored dry on micropalaeontological slide); Kwan Phayao (lake); 6 Oct. 2007; MSU.ZOC.265 • 9 ♀♀ (in 70% ethanol); same locality as for holotype; 4 Oct. 2010; MSU.ZOC.266.

#### Type locality

A total of 15 female specimens (1 holotype, 14 paratypes) were collected at the type locality on 4 Oct. 2010 and 3 female specimens (in 70% ethanol) were collected at the type locality on 8 Feb. 2011. Accompanying ostracod fauna (4 Oct. 2010): *Alicenula* sp., *Bradleystrandesia weberi* (Moniez, 1892), *Bradleytriebella lineata* (Victor & Fernando, 1981), *Cypretta* sp.1, *Cypretta* sp.2, Cypridopsine sp., *Dentocypria chantaranothaii* Savatentalinton, 2017, *Metacypris srisumona* (Savatentalinton *et al.*, 2008), *Pseudocypretta maculata* Klie, 1932, *Pseudostrandesia mamarilorum* (Victor & Fernando, 1981), *Pseudostrandesia striatoreticulata* (Klie, 1932), *Stenocypris* sp., *Strandesia hornei* Savatentalinton & Martens, 2010, *Strandesia kraepelini* (Müller, 1906); accompanying ostracod fauna (8 Feb. 2011): *Cypretta* sp.1, *Cypretta* sp.2, Cypridopsine sp., *Bradleystrandesia weberi*, *Pseudocypretta maculata*, *Pseudostrandesia mamarilorum*, *Pseudostrandesia striatoreticulata*, *Stenocypris* sp., *Strandesia kraepelini*.



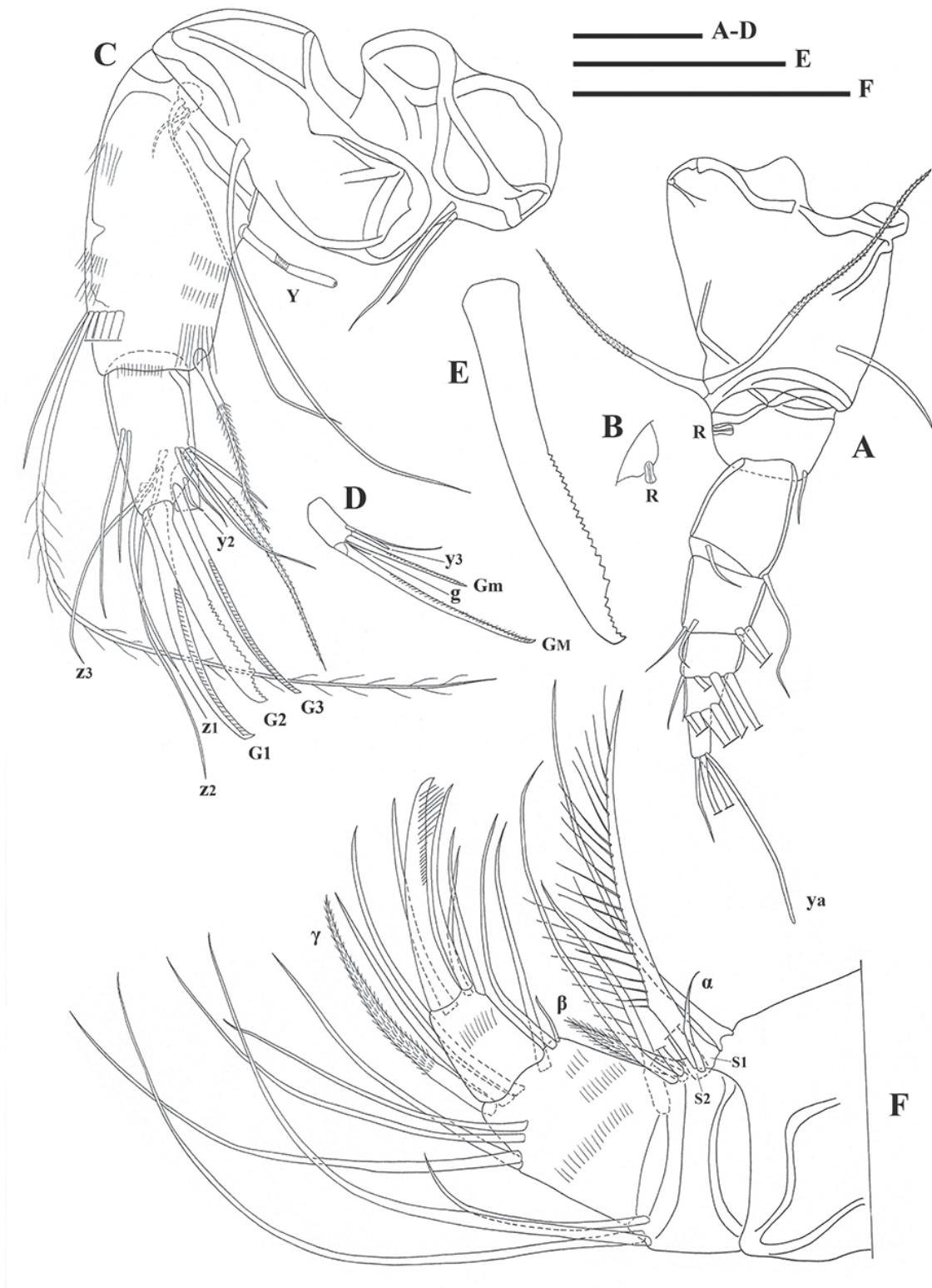


**Fig. 1.** *Thaicypridopsis longispinosa* sp. nov., ♀♀. **A.** LVe (MSU-ZOC.257). **B.** RVe (idem). **C.** CpD (MSU-ZOC.259). **D.** Valve surface (MSU-ZOC.257). **E.** Muscle scars of RV (MSU-ZOC.258). **F.** LVi (idem). **G.** RVi (idem). **H.** Posterior part of LVi (idem). **I.** Anterior part of LVi (idem). **J.** Anterior part of RVi (idem). **K–L.** Posterior part of RVi (idem). Scale bars: A–C, F–K = 100 µm; D, L = 10 µm; E = 13 µm; H–K = 58 µm.

**Other material examined**

THAILAND – **Phayao Province (N)** • 7 ♀♀; locality 1; Kwan Phayao (lake), Muang District; 19°09'33" N, 99°54'36" E; 6 Oct. 2007; accompanying ostracod fauna: *Astenocypris papyracea* (Sars, 1903), *Bradleystrandesia weberi*, *Bradleytriebella lineata*, *Cypretta* sp., *Cypridopsis vidua*, *Cypridopsine* sp., *Cypris subglobosa* Sowerby, 1840, *Dentocypris smithi* Savatnalinton, 2017, *Pseudostrandesia calapanensis* (Tressler, 1937), *Pseudostrandesia mamarilorum*, *Stenocypris malayaica* Victor & Fernando, 1981, *Strandesia kraepelini*, *Tanocypris siamensis* Savatnalinton & Martens, 2009; TH142. – **Roi-Et Province (NE)** • 19 ♀♀; locality 2; Lam Phayom (reservoir); 16°17'17" N, 103°59'46" E; 25 Oct. and 20 Feb. 2010; accompanying ostracod fauna: *Bradleystrandesia weberi*, *Bradleytriebella lineata*, *Cypridopsine* sp., *Dentocypris aequiloba*, *Dentocypris chantaranothaii*, *Limnocythere* sp., *Pseudocypretta maculata*, *Pseudostrandesia thailandensis* Savatnalinton & Martens, 2010, *Stenocypris derupta* Vávra, 1906, *Strandesia kraepelini*, *Strandesia sexpunctata* Klie, 1932, *Strandesia* sp.; NE067. – **Chaiyaphum Province (NE)** • 5 ♀♀; locality 3; Nong PagPung (swamp), Phu Kiew District; 16°22'27" N, 102°08'02" E; 30 Oct. 2010; accompanying ostracod fauna: *Candona* sp., *Cypridopsine* sp., *Dentocypris aequiloba*, *Pseudocypretta maculata*, *Stenocypris* sp., *Strandesia kraepelini*, *Strandesia sexpunctata*; NE073. – **Chaiyaphum Province (NE)** • 2 ♀♀; locality 4; Nong Sammuen (swamp), Phu Kiew District; 16°24'27" N, 102°02'02" E; 30 Oct. 2010; accompanying ostracod fauna: *Metacypris srisumoniae*, *Alicenula* sp., *Bradleystrandesia weberi*, *Cypretta* sp., *Dentocypris aequiloba*, *Dentocypris chantaranothaii*, *Pseudostrandesia mamarilorum*, *Strandesia kraepelini*, *Strandesia sexpunctata*; NE074. – **Chaiyaphum Province (NE)** • 2 ♀♀; locality 5; Lam Nam Kam (rivulet), Muang; 15°46'37" N, 102°13'18" E; 3 Oct. 2010; accompanying ostracod fauna: *Bradleystrandesia weberi*, *Chrissia* sp., *Cypretta* sp. 2, *Cypridopsis vidua*, *Cypridopsine* sp., *Dentocypris aequiloba*, *Dentocypris chantaranothaii*, *Pseudocypretta maculata*, *Pseudostrandesia gaetani* Savatnalinton & Martens, 2010, *Pseudostrandesia mamarilorum*, *Strandesia kraepelini*, *Strandesia sexpunctata*; NE007. – **Chaiyaphum Province (NE)** • 2 ♀♀; locality 6; Huai Pao (river), Kaset Sombun District; 16°23'03" N, 101°58'47" E; 9 Oct. 2007; accompanying ostracod fauna: *Cypretta* sp., *Cypris subglobosa*, *Dentocypris chantaranothaii*, *Dentocypris smithi*, *Dolerocypris sisaketensis* Savatnalinton & Suttajit, 2016, *Pseudostrandesia mamarilorum* (Victor & Fernando, 1981), *Strandesia kraepelini* (Müller, 1906), *Strandesia sexpunctata* Klie, 1932; TH152. – **Ubon Ratchathani Province (NE)** • 2 ♀♀; locality 7; Kang Sapue (river), Phiboon Mangsahan District; 15°14'37" N, 105°14'37" E; 24 Oct. 2010; accompanying ostracod fauna: *Chrissia* sp., *Cypridopsine* sp., *Pseudocypretta maculata*, *Pseudostrandesia calapaensis* (Tressler, 1937), *Pseudostrandesia gaetani*, *Strandesia kraepelini*, *Strandesia sexpunctata*; NE057. – **Buriram Province (NE)** • 2 ♀♀; locality 8; Chon Pratan Reservoir, Lampaimas District; 15°01'05" N, 102°50'29" E; 8 Feb. 2011; accompanying ostracod fauna: *Bradleystrandesia weberi*, *Dentocypris aequiloba*, *Pseudostrandesia thailandensis*, *Stenocypris derupta*, *Stenocypris* sp., *Strandesia kraepelini*; NE094. – **Udon Thani Province (NE)** • 2 ♀♀; locality 9; Nong Kae (swamp), Muang district; 17°27'59" N, 102°48'39" E; 31 Jan. 2011; accompanying ostracod fauna: *Alicenula* sp., *Bradleystrandesia weberi*, *Chrissia* sp., *Cypretta* sp., *Cypridopsis vidua*, *Cypridopsine* sp., *Dentocypris aequiloba*, *Fabaeformiscandona* sp., *Metacypris srisumoniae*, *Pseudocypretta maculata*, *Pseudostrandesia mamarilorum*, *Stenocypris derupta*, *Stenocypris* sp., *Strandesia hornei*, *Strandesia kraepelini*; NEN029. – **Udon Thani Province (NE)** • 2 ♀♀; locality 10; Huai Luang (reservoir), Muang district; 17°28'20" N, 102°49'12" E; 31 Jan. 2011; accompanying ostracod fauna: *Alicenula* sp., *Chrissia* sp., *Cypretta* sp. 1, *Cypretta* sp. 2, *Dentocypris aequiloba*, *Pseudocypretta maculata*, *Strandesia kraepelini*; NEN030. – **Mukdahan Province (NE)** • 10 ♀♀; locality 11; Nong Lom (swamp), Don Tan District; 16°24'18" N, 104°51'30" E; 19 Dec. 2011; accompanying ostracod fauna: *Cypridopsis vidua*, *Cypridopsine* sp., *Dentocypris aequiloba*, *Dolerocypris* sp., *Ilyocypris* sp., *Limnocythere* sp., *Pseudocypretta maculata*, *Strandesia kraepelini*, *Strandesia perakensis*, *Strandesia sexpunctata*; NEE003.

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**Fig. 2.** *Thaicypripopsis longispinosa* sp. nov., ♀♀. **A.** A1 (MSU-ZOC.264). **B.** Rome organ of A1 (MSU-ZOC.257). **C.** A2 (idem). **D.** Distal segment of A2 (idem). **E.** Claw G2 of A2 (idem). **F.** Md-palp (MSU-ZOC.263). Scale bars: 50  $\mu$ m.



## Diagnosis

Cp in lateral view subovate (length c. 1.5 times height) with maximum height situated at mid-length, anterior and posterior ends subequally rounded. CpD elliptical with maximum width situated slightly behind mid-length. LV overlapping RV all free margins. LV posterior part with double inner list, appearing well developed, but not oblique. RVi with a submarginal row of distinctive tubercles (c. 18–20 tubercles) on postero-ventral part. Valve surface equipped with shallow pitted, dispersedly long setae and markedly long spines. Claw G2 on A2 strongly serrated with apical concavity, natatory setae long (far beyond end of terminal claw), four t-setae present in females with one seta claw-like appearance. Robust claw on Md-palp terminal segment with apical group of hairs. Terminal segment of Mx1-palp cylindrical and elongated, large bristles on three endites claw-like with hirsute endings and spatula-shaped apices, number of large bristles on first to third endite being 1, 1, 2, respectively. T1 with two a-setae (b-, c- and d-setae absent). Seta d2 on T2 present (d1 absent), terminal claw with slightly bifurcate ending. CR reduced, flagellum-like with triangular base.

## Differential diagnosis

As *Thaicypridopsis* gen. nov. is a monospecific genus, the new species is compared with related species in other genera within the Cypridopsinae (also see Discussion below). The new species is superficially similar to *Cabelodopsis hispida* (Sars, 1901) Higuti & Martens, 2012 and *Zonocypris costata* (Vávra, 1897) due to the presence of a strongly serrated claw G2 on the A2 and of the tubercles on the postero-ventral part of the RVi. The new species can be distinguished mainly by the robust apical claw on the terminal segment of the Md-palp with hairy ending (smooth and pointed endings in *C. hispida* and *Z. costata*), the morphology of the large bristles on three Mx1-endites, which appear as hirsute endings and spatula-shaped apices, and the presence of a bifurcated tip on the T2 terminal claw (smooth tip in *C. hispida* and *Z. costata*).

## Measurements (in $\mu\text{m}$ )

Cp (n=2), L = 528–584, W = 334–378; LV (n=3), L = 534–588, H = 349–408; RV (n=3), L = 507–578, H = 346–397.

## Description

### Female

CP IN LATERAL VIEW. Subtriangular, anterior margin rounded, posterior margin slightly wider rounded, dorsal margin strongly arched, greatest height situated at mid-length, LV overlapping RV all free margins, valve surface pitted and equipped with setae and long spines (Fig. 1A–B), surface of long spines slightly serrated (Fig. 1D).

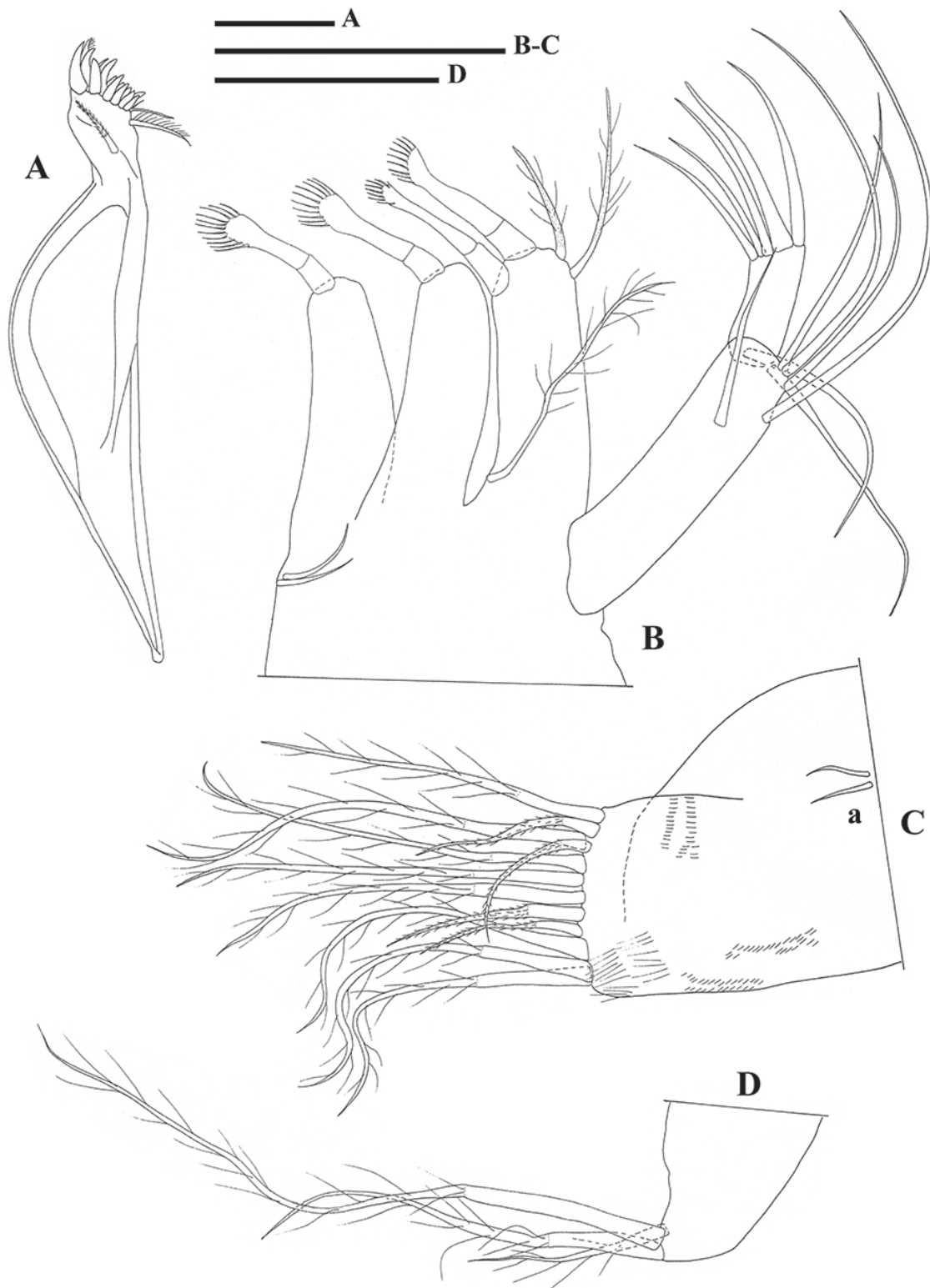
CPD (Fig. 1C). Subovate with evenly curved lateral margins, greatest width situated slightly behind mid-length, posterior extremity round, anterior extremity more pointed.

LV<sub>I</sub> (Fig. 1F, H–I). Both anterior and posterior margins subequally rounded, ventral margin sinuous at mid-length, submarginal selvage anteriorly, anterior calcified inner lamella wide with two inner lists, posterior calcified inner lamella narrow with double inner list being well developed but not oblique, postero-ventral part with submarginal shallow sockets or pits (conforming to tubercles on RV).

RV<sub>I</sub> (Fig. 1E, G, J–L). Both anterior and posterior margins subequally rounded, ventral margin sinuous at mid-length, submarginal selvage anteriorly, anterior calcified inner lamella wide, posterior calcified inner lamella narrow with two inner lists, postero-ventral part with c. 18–20 prominent tubercles.

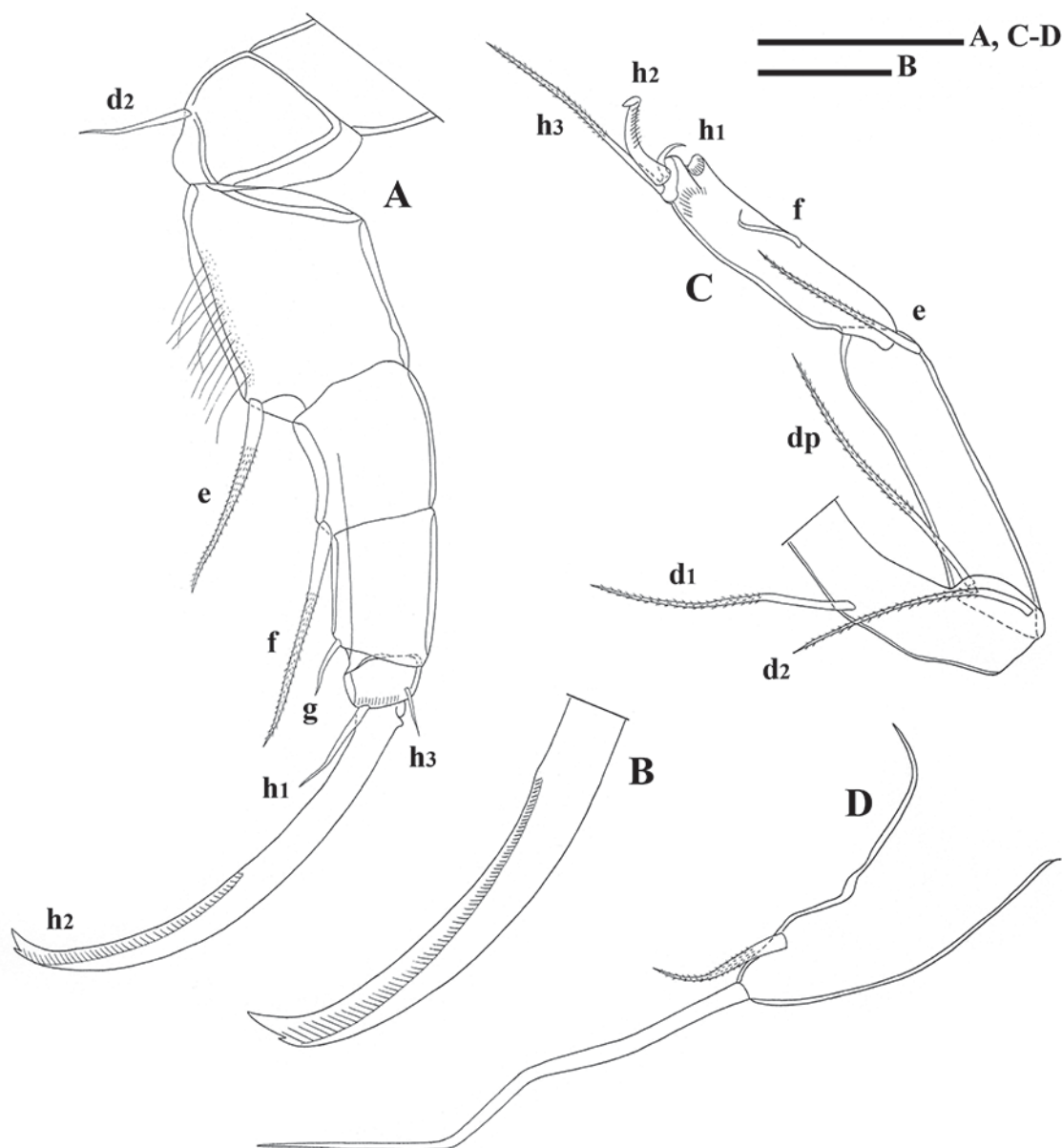


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**Fig. 3.** *Thaicypridopsis longispinosa* sp. nov., ♀♀. **A.** Md-coxa (MSU-ZOC.257). **B.** Mx-1 (MSU-ZOC.264). **C.** T1 (idem). **D.** Endopodite of T1 (idem). Scale bars: 50  $\mu$ m.

A1 (Fig. 2A–B). Seven-segmented, first segment with one short dorso-subapical seta (reaching tip of next segment) and two long ventro-apical setae. Second segment slightly wider than long, with one short dorso-apical seta (reaching half of next segment) and Rome organ. Third segment bearing two setae: one long dorso-apical (reaching beyond tip of penultimate segment) and one short ventro-apical setae (reaching slightly beyond half of next segment). Fourth segment with two long dorsal setae and two short ventral setae (both reaching slightly beyond tip of next segment). Fifth segment dorsally with two long setae, ventrally with two (one long, one short) setae, short one reaching slightly beyond tip of next segment. Penultimate segment with four long apical setae. Terminal segment with three (two long, one short) apical setae and long aesthetasc ya, length of aesthetasc ya c. length of last four segments, length of short seta slightly less than half of that of aesthetasc ya.



**Fig. 4.** *Thaicypridopsis longispinosa* sp. nov., ♀♀. **A.** T2 (MSU-ZOC.257). **B.** Distal part of T2 terminal claw (idem). **C.** T3 (idem). **D.** CR (MSU-ZOC.264). Scale bars: A, C = 50 µm; B, D = 20 µm.

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A2 (Fig. 2C–E). Basal segment with two proximal setae and one long ventro-apical seta. Exopodite with three (one long, two short) setae, long one reaching slightly beyond half of penultimate segment. First endopodal segment with five very long (reaching far beyond tips of terminal claws) and one short natatory seta, length of the shortest seta reaching three fourth of penultimate segment, aesthetasc Y long, ventro-apical seta long, extending beyond tip of terminal segment. Penultimate segment undivided, distally with three serrated claws (G1–G3), G1 and G2 large, G2 strongly serrated apically with concave apex, G3 slender claw, aesthetasc y2 long (not reaching tip of terminal segment), z1–z3 setae long, Z1 slightly larger than other z setae, z2 longest (beyond tip of claws G1–G3); this segment medially with two subequally long dorsal setae, four ventral setae of unequal length (t1–t4), one t seta claw-like appearance. Terminal segment distally with two serrated claws (GM and Gm), length of Gm c.  $\frac{2}{3}$  of that of GM; medially with short g seta and ventral aesthetasc y3, length of aesthetasc y3 c. half of accompanying seta.

MD-PALP (Fig. 2F). First segment with two large setae (S1 and S2), one long and slender seta, and a short, smooth  $\alpha$ -seta. Second segment dorsally with three unequal long apical setae, shortest seta reaching tip of next segment; ventrally with group of three long hirsute setae, one shorter hirsute seta and plumose, cone-shaped  $\beta$ -seta with pointed tip. Penultimate segment consisting of three groups of setae: dorsally with group of four unequal, long, subapical setae; laterally with apical  $\gamma$ -seta and three further apical smooth setae, the former slightly plumose (length c. 2.4 times of terminal segment); ventrally with two subapical setae, one long (reaching beyond tip of terminal segment), one short (c. half of terminal segment). Terminal segment bearing three claws and two shorter setae, largest claw appearing strongly robust with hairy ending.

Mx1 (Fig. 3B). With two-segmented palp, basal segment of palp dorsally with group of six long, unequal apical setae; ventrally with one long subapical seta (reaching slightly beyond tip of terminal segment). Terminal segment elongated (length c. 2 times of width), apically with three claws and two setae. Large bristles on endites claw-like, with hirsute ending and spatula-shaped apex, number of large bristles on first to third endites being 1, 1, 2, respectively. Sideways-directed bristles on first endite short, subequal in length.

T1 (Fig. 3C–D). Protopodite with two unequally short a-setae, b-, c- and d-setae absent, distally with 12 hirsute apical setae of unequal length. Endopodite weakly built palp with one very long, hirsute seta and two unequally shorter apical setae, length of shortest one less than  $\frac{1}{3}$  of long one.

T2 (Fig. 4A–B). With d2 seta (d1 absent). Second segment with long e-seta (length c.  $\frac{2}{3}$  of penultimate segment). Penultimate segment divided, proximal segment bearing long f-seta (reaching beyond tip of terminal segment), distal segment with short apical g-seta (reaching tip of terminal segment). Terminal segment with two (one dorsally, one ventrally) apical h1 and h3 setae (length of the former less than  $\frac{1}{3}$  of claw, the latter short) and serrated claw (h2) with slightly bifurcated tip, length of h2 longer than that of penultimate segment.

T3 (Fig. 4C). A cleaning limb. First segment with subequal long d1, d2, dp setae. Second segment with long apical e-seta (reaching half of next segment). Third segment with short f-seta (not reaching tip of segment). Terminal segment with an apical pincer and one reflexed subapical seta, length of the latter slightly shorter than that of third segment.

CR (Fig. 4D). Reduced, flagellum-like with triangular base, laterally with short subapical seta, length of long seta c. 1.7 times of that of ramus and c. 3.8 times of that of short subapical seta.

### Male

Unknown.

**Key to genera with LV overlapping RV in the subfamily Cypridopsinae**

1. Respiratory plate of T1 absent ..... *Austrocypridopsis* McKenzie, 1982  
– Respiratory plate of T1 present ..... 2
2. Claw G2 on A2 strongly serrated ..... 3  
– Claw G2 on A2 normal developed ..... 5
3. Terminal claw of T2 with bifurcate end, large setae on Mx1 endites with spatula-shaped apex, valve surface without circular ridges ..... *Thaicypridopsis* gen. nov.  
– Terminal claw of T2 without bifurcate end, large setae on Mx1 endites without spatula-shaped apex ..... 4
4. Hinge simple and adont, valve surface without circular ridges .....  
..... *Cabelodopsis* Higuti & Martens, 2012  
– Hinge well developed, valve surface with prominent circular ridges ..... *Zonocypris* Müller, 1898
5. Pincer organ on T3 absent ..... *Neocypridopsis* Klie, 1940  
– Pincer organ on T3 present ..... 6
6. CR absent in female and male ..... *Pseudocypridopsis* Karanovic, 1999  
– CR present in female ..... 7
7. Carapace elongated, marginal fused zone somewhat broad, A2 natatory setae short .....  
..... *Cavernocypris* Hartmann, 1964  
– Carapace more ovated, marginal fused zone (if present) narrow, mostly A2 natatory setae long .... 9
8. Right prehensile palp with wing-like expansion on terminal segment, A2 aesthetasc Y 2-segmented  
..... *Tungucypridopsis* Victor, 1983  
– Right prehensile palp without wing-like expansion on terminal segment, A2 aesthetasc Y 3- or  
4-segmented ..... *Cypridopsis* Brady, 1867

**Discussion****Morphology and taxonomy**

The subfamily Cypridopsinae, based on the valve overlap, is divided into two groups: the LV overlapping the RV and the RV overlapping the LV. The former group which comprises nine genera, including the new genus, is also united by the cylindrical and elongated shape of the terminal segment of the Mx1-palp. However, it should be emphasized that this group is not monophyletic because it includes two tribes: Zonocypridini and Cypridopsini (see Higuti & Martens 2012). The grouping standing on the valve overlap is merely suitable for the identification key as the valve overlap is primarily the most easily recognized character.

Among the cypridopsine species, the new species seems to resemble the *Cypridopsis* representatives, but its limbs' morphology is different in many aspects, especially the strongly serrated claw G2 on the A2, the large bristles with spatula-shaped apex on the Mx1-endites and the T2 terminal claw with bifurcate tip. These features of the new species are not found in the *Cypridopsis*. The presence of a submarginal row of the tubercles on the postero-ventral part of the RVi is a prominent character in the new genus. This aspect leads to the affinity between the new genus and a few other cypridopsine genera, namely *Cabelodopsis*, *Klieopsis*, *Siamopsis* and *Zonocypris*. At an identical position, the first three genera have septa-like or tiny tubercle(-like) structures (see Martens *et al.* 1991; Higuti & Martens



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2012; Savatentalinton 2017), while a submarginal row of prominent tubercles appears in the new genus and *Zonocypris costata* (Vávra, 1897) (Müller 1898, as *Zonocypris madagascarensis*). The presence of these tubercles and structures is thus a homologous character. Among these five genera, *Thaicypridopsis* gen. nov. and *Z. costata* are likely more advanced due to the most well-developed form of tubercles. *Thaicypridopsis* gen. nov. and *Z. costata* have the LV overlapping the RV and the obvious tubercles occur on the smaller valve. This is similar to the case of the subfamily Cyprinotinae, where the smaller valve also has tubercles (see, for example, Broodbakker 1983; Martens 1984; Martens & Wouters 1985; Meisch 2000; Savatentalinton & Martens 2008). Nevertheless, the position of tubercles is obviously different. They appear between the valve margin and the inner list in *Z. costata* and the new genus whereas in Cyprinotinae, they are on the valve margin. This indicates that these tubercles are not homologous structures in these two groups. Due to the presence of tubercles on the smaller valve and complementary shallow sockets (pits) on the larger valve (see Fig 1H, K–L), these structures could possibly relate to the valve closure. The septa-like or tubercle-like structures appearing on the larger valve, as in the case of *Klieopsis* and *Siamopsis*, would imply that these features seem to display different functions. To date, there are no such tubercles recognized on the LV in the Cypridopsinae.

Based on the morphology of the soft parts, especially the strong serrated claw G2 of the A2, the new genus belongs to the tribe Zonocypridini Higuti & Martens, 2012 accompanying *Zonocypris* and *Cabelodopsis* (see Higuti & Martens 2012). The strong serration on the claw G2 of the A2 is regular (without an apical concavity), as seen in *Zonocypris* species (see, for example, Müller 1898; Rome 1969; Klie 1936, 1944) while in the new genus, the serrated margin is concave apically (see Fig 2C, E). Such irregular serration has not yet been mentioned in the subfamily Cypridopsinae, except for the new genus.

The claws on the terminal segment of the Md-palp are smooth with pointed ends in the cypridopsine genera. The exception occurs in *Tanganyikacypridopsis* (see Martens 1985), *Thermopsis* (see Kulköylüoğlu *et al.* 2003) and *Thaicypridopsis* gen. nov., in which one large claw is apically equipped with a group of hairs. It should be noted that this feature should be used with caution as it would not be illustrated, even if it exists, in many older descriptions.

The morphology of the Mx1-endites in the new genus is remarkable as the large setae (bristles) are apically hirsute and spatula-shaped and they appear on all three endites. These striking setae are indicative and have not been recognized in any cypridopsine genera. Most genera in the Cypridopsinae have large bristles (Zahnborsten) only on the third endite. An exceptional case was encountered in *Z. costata*, in which large bristles were also found on the second one. However, the ending of the bristles is pointed in *Z. costata*, whereas the spatula-shaped ending represents the new genus. The Mx1-endites are known as the feeding apparatus as they possess a number of strong apical setae. In the Cyprididae species, the first two endites are equipped with monomorphic masticatory apical setae with different length, while the heteromorphic setae only occur on the third one, typically exhibiting two large bristles together with the normal setae. The large bristles can be either smooth or serrated apically and their number can be more than two in some genera, such as *Oncocypris* (see, for example, Green 1973; Rome 1962; Klie 1938, 1939; Savatentalinton 2015). Such qualitative and/or quantitative modification strongly reinforces the masticatory function of the Mx1. In the new genus, based on the morphology of the modified setae on the Mx1-endites, which look like brushes, their function is unlikely restricted to mastication.

The tip of the T2 terminal claw (h2) is slightly bifurcated in *Thaicypridopsis* gen. nov. It can be easily recognized under medium magnification (c. 100 times). Before the present study, this feature had never been noticed in Cypridopsinae, while it is one of the diagnostic characters of the genus *Oncocypris*. The morphology of the T2 terminal claw is very slightly different between *Thaicypridopsis* gen. nov. and *Oncocypris*. Whereas the outer margin of the claw is slightly sinuated in some *Oncocypris*, such as *O. debundshae* (Green 1973), *O. euglypha* (Rome 1962) and *O. rostrata* (Savatentalinton 2015), it is

smooth in the new genus. In *Thaicypridopsis* gen. nov., the terminal segment of the T3 possesses the pincer organ, which is identical to that of other cypridopsine genera.

As the new genus shares some characters with *Oncocypris*, this allows to further discuss the taxonomic position of the subfamily Oncocypridinae which has *Oncocypris* as the type genus. The main characters which keep the subfamily Oncocypridinae in the family Notodromadidae are the presence of the separate eye cups and the four or five large bristles (Zahnborsten) on the third Mx1 endite (for example, see Savatentalinton 2015) whereas the reduced CR seems to place Oncocypridinae in the subfamily Cypridopsinae. One conceivable solution of such a situation is that Oncocypridinae could be the fourth tribe in the subfamily Cypridopsinae. This viewpoint can also be supported by the morphology of the T2 which relates *Oncocypris* to the cypridopsine genus, *Thaicypridopsis* gen. nov. In this way, the family Notodromadidae is no longer a polyphyletic group (see Diaz & Martens 2018).

Consequently, *Thaicypridopsis* gen. nov. shares some valve and soft part characters mostly with *Cabelodopsis*, *Zonocypris*, *Klieopsis*, *Siamopsis* and *Oncocypris*. The distinguishing features of the new genus mentioned above are taxonomically important differences supporting its position as a separate genus within the subfamily Cypridopsinae.

### Ecology and distribution

*Thaicypridopsis longispinosa* sp. nov. was encountered in reservoirs, lakes, swamps and rivers in the northern and northeastern parts of Thailand. As large populations occur in reservoirs and lakes (Huai Jorakae Mak, Kwan Phayao and Lam Phayom), in which the peripheral zones were densely occupied by aquatic plants, this could be its favorable habitats. The distribution of the new species was wide in the northeastern part while in the northern part it was encountered only in one locality (Kwan Phayao, point 1 in Fig. 5), and there was no record in the central part. It should also be noted that the number of sampling localities from the northeastern part was high with 236 localities from 17 provinces whereas there were 54 localities from 13 provinces in the northern part and three localities from only one province in the central part. At present, *T. longispinosa* sp. nov. is a rare species in the country as it was found in



**Fig. 5.** Distribution map of *Thaicypridopsis longispinosa* sp. nov. (\* = type locality; numbers = localities mentioned in “Other material examined” section).

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12 of 293 surveyed localities (Fig. 5). The discovery of *T. longispinosa* sp. nov. is the first record of the Recent representative of the tribe Zonocypridini in Southeast Asia and the Oriental region.

According to the Recent materials and the fossil evidence, there seems to be four lineages within Zonocypridini with respect to the zoogeographical regions, namely Afrotropical, Palaeartic, Neotropic and Oriental lineages. This tribe could originate from the Afrotropical region because it is the center of origin. In addition, *Zonocypris* which is the most representatives of the tribe, is presently found on the African continent with high endemicity. The Oriental lineage could have evolved from the African ancestor after the Upper Cretaceous due to the fact that the Indian subcontinent was connected to East Africa during the Upper Cretaceous. However, the current data on fossil records show the different phenomenon. The oldest fossils of *Zonocypris* are from the Cretaceous of Europe, China, India and South America, while the fossils of African *Zonocypris*, which were recovered from the Miocene sediments, are more recent (Mazzini 2011). Nonetheless, their actual evolutionary pathways should be logically judged after extensive surveys of ostracod fossils are accomplished in these regions.

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