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A new pelagic *Polyconchoecia* Xiang, Chen and Du, 2018 (Ostracoda: Myodocopa: Halocyprididae) from the South China Sea

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Abstract

Halocyprid ostracods are appreciable part of ostracods floating through virtually everywhere in marine environment. In this study, we describe a new species of genus *Polyconchoecia* Xiang, Chen and Du, 2018, tribe Conchoeciini Chavtur and Angel, 2011, family Halocyprididae Dana, 1853 from the middle of the South China Sea. *Polyconchoecia chenii* sp. nov. is very close to *P. commixtus* Xiang, Chen and Du, 2018. But it differs from *P. commixtus* by the distinctions of locations of major glands of carapace and the characteristics of appendages: more posteriorly situated left asymmetric gland of carapace, no right asymmetric gland; segmented frontal organ; the endopod 2 of the first antenna with a very small seta; a- and c-setae of the first antenna with long end joint have long end joint, the b- and d-setae have no end joint, spinose e-seta without end joint; the e-seta of the second antenna is present; teeth side is distinctive; the setal counts of the mandible, maxilla, fifth limb, and sixth limb are individual. The locations of the major glands on carapace and the characteristics of the first antenna can be the key of the new species. This work is the second discovery of the genus *Polyconchoecia* from the world.

Key words: taxonomy, Ostracoda, Halocyprididae, Conchoeciini, *Polyconchoecia chenii* sp. nov., new species, South China Sea

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1 Introduction

Class Ostracoda Latreille, 1802, emend. Martin and Davis, 2001 are a big group of small bivalved crustaceans. They inhabit almost all aquatic environments with high taxonomic diversity (Karanovic, 2010). Ostracods are one of the momentous groups of marine organisms, and are functionally important in the process of bio-geo-chemical cycles in marine ecosystem, especially in the tropics and subtropical regions (Angel et al., 2007; George and Nair, 1980). They also play a significant participant of marine deposition, because their calcified valves are preserved as fossils (Di Celma et al., 2016). The studies of ostracods have been well improved in last two decades, and many new taxa have been erected (Harrison-Nelson and Kornicker, 2000; Chavtur, 2003; Lum et al., 2008; Karanovic, 2010; Chavtur and Angel, 2011; Pinto and Jocqué, 2013; Xiang et al., 2017a, b, 2018; Du et al., 2018). These faunae might no-monophyletic, phylogeny remains indistinct, and classification is based on typical characteristics (Fortey and Thomas, 1998; Yamaguchi and Endo, 2003).

Halocyprid ostracods constitute appreciable part of marine zooplankton. They are floating through virtually everywhere in marine environment including surface, hydrothermal vent, cold seep and abyss (van Harten, 1992; Oakley et al., 2013; Tanaka and Yasuhara, 2016; Yamaguchi et al., 2016). In 1853, the largest family Halocyprididae Dana, 1853 (Chavtur, 2003; Martin and Davis, 2001; Brandão et al., 2019) within order Halocyprida Dana, 1853 was erected. And then, the subfamily Conchoeciinae Müller, 1912 was erected under this family. In 2011, Chavtur and Angel (2011) designated the tribe Conchoeciini Chavtur and Angel, 2011 on the basis of the locational shifts of glands. Not long ago, Du et al. (2018) erected genus *Polyconchoecia* Xiang, Chen and Du, 2018 with the type species *P. commixtus* Xiang, Chen and Du, 2018 based on the definite characteristics of locations of major glands on carapace. Soon after that, genus *Conchoecia* Dana, 1849 was subdivided into five genera: *Conchoecia*; *Macrochoecilla* Chavtur, 2018; *Lophuroecia* Chavtur, 2018; *Parvidentoecia* Chavtur, 2018; and *Hyalocoecia* Chavtur, 2018; and genus *Parthenoecia* Chavtur, 2018 was erected, mainly based on characteristics of lateral gland, armature of seta-e on the first antenna in the male, and copulatory appendage (Chavtur and Bashmanov, 2018). Thus far, the tribe Conchoeciini has contained 27 genera (Brandão et al., 2019).

In this study, a new species of genus *Polyconchoecia* from the South China Sea was described.

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2 Methods

2.1 *Sampling and morphological methods*

Collections were obtained from two cruises of the South China Sea in 2014–2015. All zooplankton specimens were collected using a Multinet sampling system (Type Midi, Mesh-size aperture 200 μm, HydroBios Inc., Kiel, Germany) by vertical and stratified hauls from bottom to surface. Collections were preserved by immersion in 5% buffered formaldehyde.

Specimens were dissected under a Carl Zeiss Discovery V20 zoom-stereomicroscope. Dissected appendages were mounted in permanent slides with CMC-9AF medium (Masters Company Inc., Illinois, USA). Observations were done by a Carl Zeiss Axio Imager Z2 differential interference contrast microscope system with AxioVision Image-Pro software (Carl Zeiss Inc., Oberkochen, Germany). All drawings were made from micro-images of dissected appendages, followed the methodology in Chavtur and Angel (2011), and further processed with Adobe Photoshop CS6 (Adobe Inc., San Jose, CA, USA).

The type specimens/appendages were deposited in the Marine Biological Sample Museum of the Chinese Offshore Investigation and Assessment, Third Institute of Oceanography, MNR (Xiamen, China), under the collection numbers TIO-OHH-PP-201 to TIO-OHH-PP-204.

Fig. 1. *Polyconchoecia chenii* sp. nov. (♀). a. Left valve, external view; b. carapace, internal view; and c. postero-ventral corner of right valve, internal view.

2.2 *Nomenclatural acts*

The electronic edition of this article conforms to the requirements of the amended International Code of Zoological Nomenclature, and hence the new names contained herein are available under that code from the electronic edition of this article. This published work and the nomenclatural acts it contains have been registered in ZooBank, the online registration system for the ICZN. The ZooBank LSIDs (Life Science Identifiers) can be resolved and the associated information viewed through any standard web browser by appending the LSID to the prefix "http://zoobank.org/". The LSID for this publication is: urn:lsid:zoobank.org:pub:C8D3334A-AA1C-4355-AB53-140B299051B0. The electronic edition of this work was published in a journal with an ISSN, and has been archived and is available from the following digital repositories: SpringerLink, PubMed Central, LOCKSS.

3 Results

3.1 *Systematics*

Oder Halocyprida Dana, 1853

Family Halocyprididae Dana, 1853

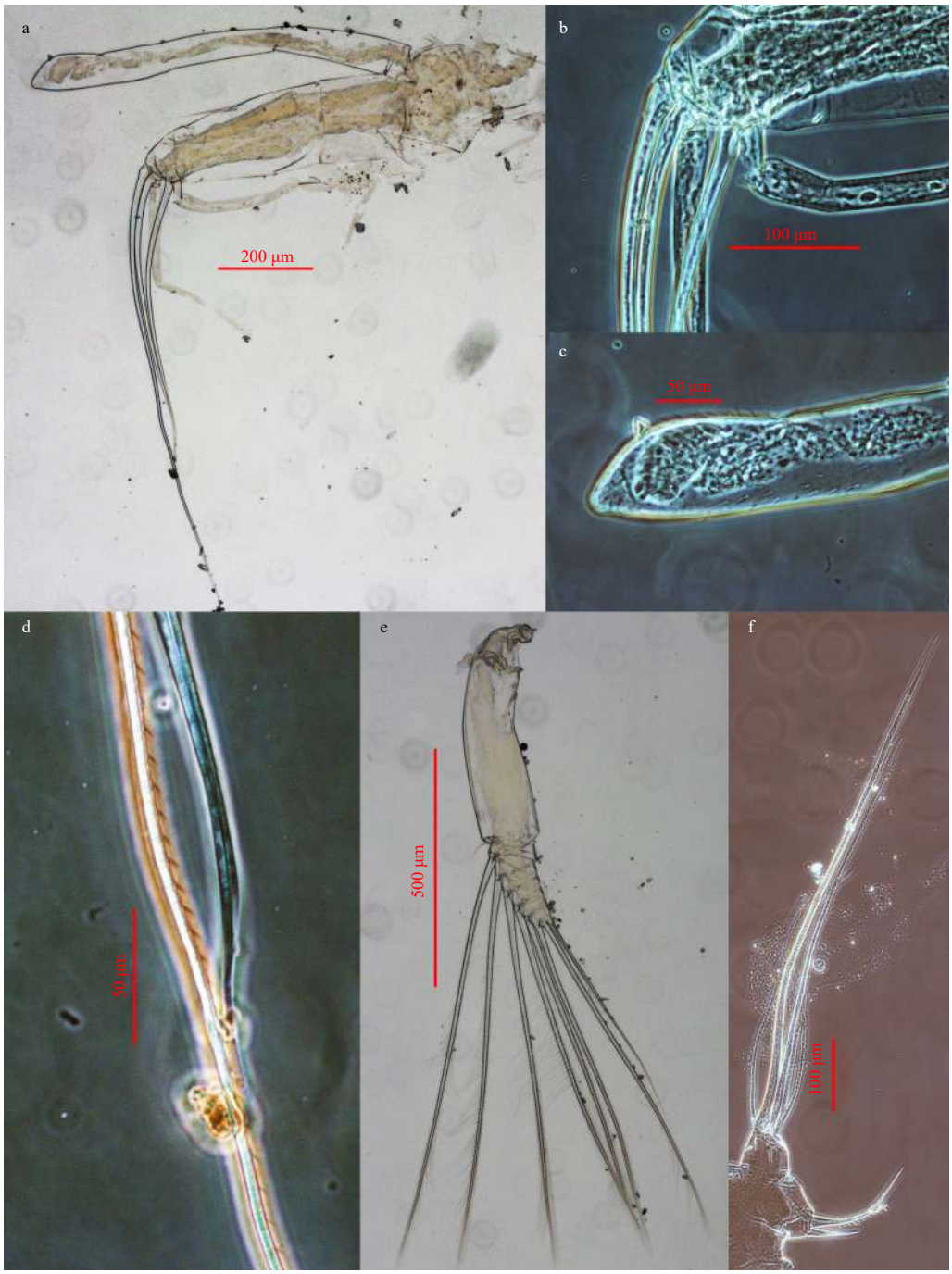

Fig. 2. *Polyconchoecia chenii* sp. nov. (♀). a. First antenna and frontal organ, external view; b. tip of first antenna, external view; c. tip of frontal organ, external view; d. detail of e-seta, external view; e. second antenna, external view; and f. exopod of second antenna, external view.

Subfamily Conchoeciinae Müller, 1912
Tribe Conchoeciini Chavtur and Angel, 2011
Genus *Polyconchoecia* Xiang, Chen and Du, 2018
Species *Polyconchoecia chenii* Xiang, Wang and Chen sp. nov.

3.2 *Species Polyconchoecia chenii sp. nov.*

Figs 1–8

LSID: urn:lsid:zoobank.org:act:9B60314F-EE85-46C7-8213-737601ED74D8

Etymology. Latinized name of Ruixiang Chen, our teacher, a scientist of the planktonic research group, Third Institute of Oceanography, MNR, in recognition of his important contributions of marine ostracods of China.

Holotype. No. TIO-OHH-PP-201, adult female, length 2.57 mm, height 1.47 mm from Sta. CS-068 (14°31′N, 114°54′E) in the top of the South China Sea, 200–500 m water layer, 12 January 2015. Specimen was dissected on slide and deposited in the Marine Biological Sample Museum, in the Third Institute of Oceanography, MNR, China (Xiamen, China).

Paratypes. No. TIO-OHH-PP-202, adult female, length 2.33 mm, height 1.35 mm, No. TIO-OHH-PP-203, adult female, length 2.45 mm, height 1.41 mm, from the same locality of the

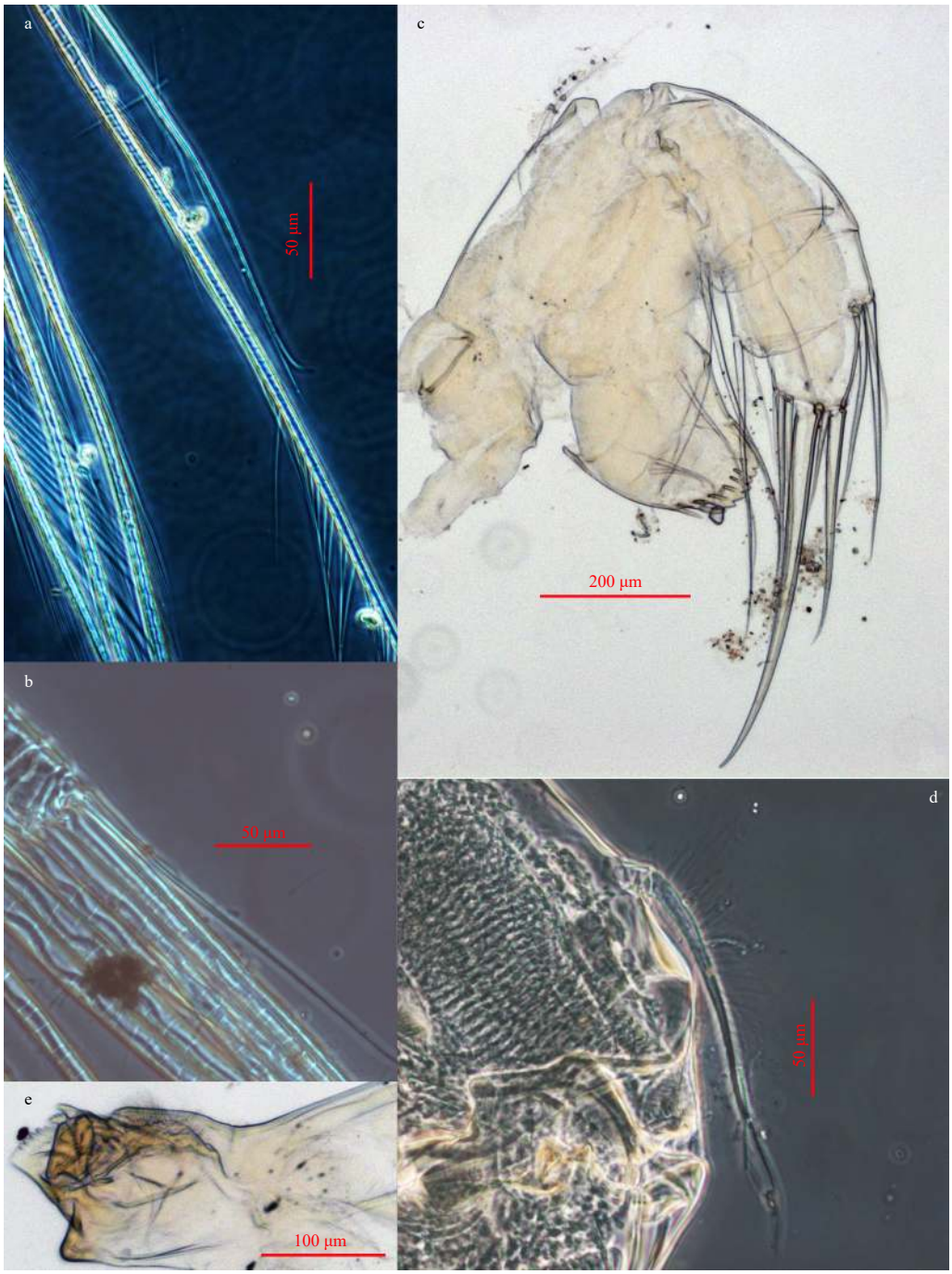

Fig. 3. *Polyconchoecia chenii* sp. nov. (♀). a. Details of swimming seta of second antenna, external view; b. terminal seta of second antenna, external view; c. mandible, internal view; d. exopod of mandible, internal view; and e. coxal endite of left mandible, internal view.

holotype, and dissected on slide. TIO-OHH-PP-204, adult female, length 2.35 mm, height 1.33 mm, collected from Sta. CS-012 (7°06.46′N, 113°53.6′E) in the South China Sea, 200–500 m water layer on 2 January 2014, deposited in 5% buffered formaldehyde. Paratypes were deposited with the holotype.

Distribution. The mesopelagic water in the South China Sea.

Diagnosis. Carapace without ornamentation or setae, height about 56.5%–57.9% of length, sub-rectangle in lateral view with rounded corners; rostrums wide, developed, equilong, anteriorly and curved to downward; shoulder vaults unconspicuous, higher in anterior part, ventral margin with slightly concave, left asymmetric gland opening on postero-dorsal corner, a lateral gland opening on right postero-ventral corner, dense edge glands placed along all ventral margin; left postero-ventral margin without gland. Frontal organ segmented. In first antenna, a- and c-setae analogic with long end joint, b- and d- setae analogic without end joint. E-seta of second antenna present. Maxilla with five disto-anterior setae, one disto-medial seta, two medial setae, and three disto-posterior setae on endopod 2. Proximal-ventral group of setae of fifth limb with seven setae, endopod 1 with two ventral setae. Vesting of exopod of sixth limb strong and spinose, basale with seven ventral plumose setae, endopod 1 bare, endo-

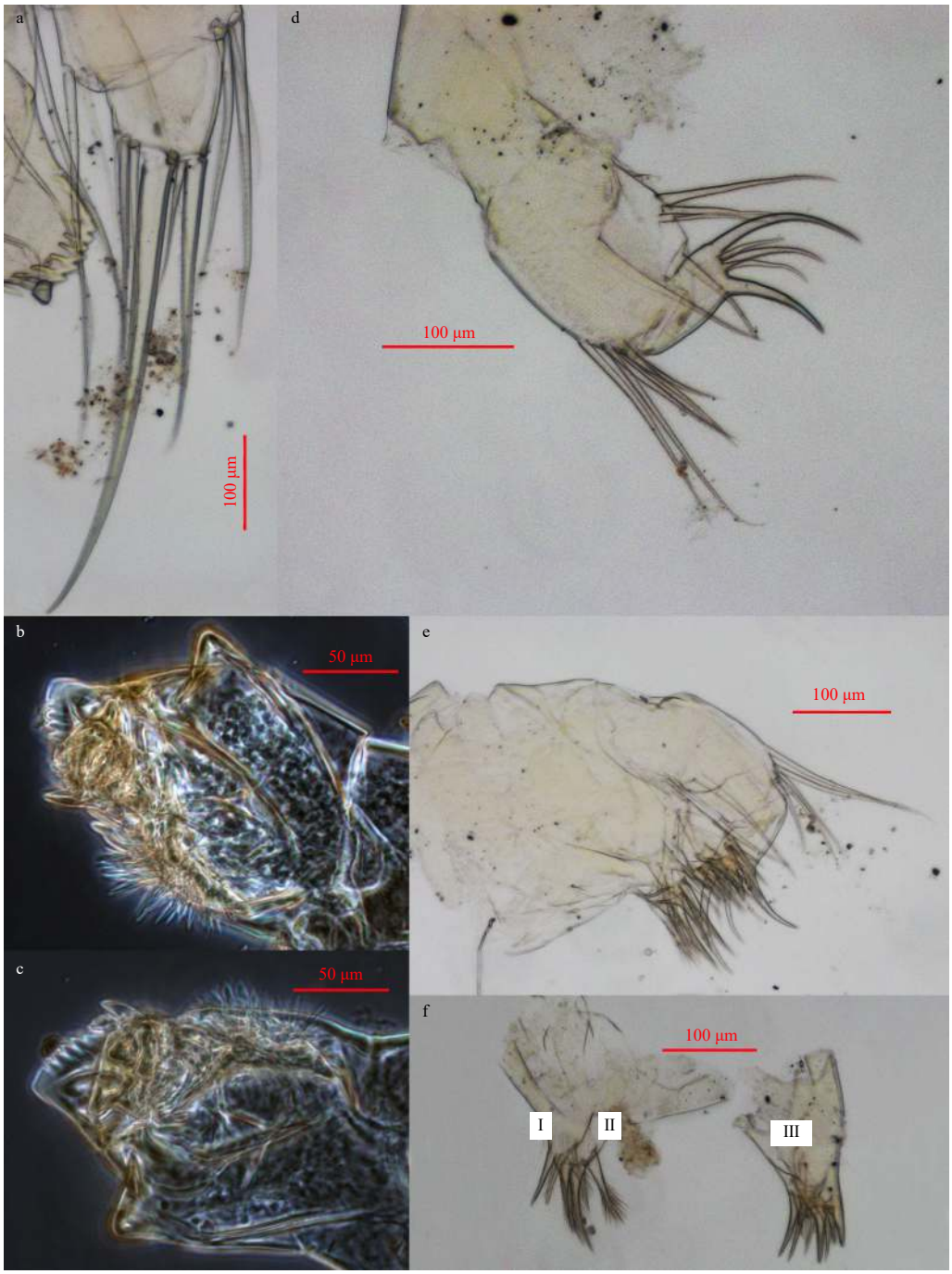

Fig. 4. *Polyconchoecia chenii* sp. nov. (♀). a. Tip of mandible, internal view; b. coxal endite of right mandible, internal view; c. coxal endite of left mandible, internal view; d. maxilla, internal view; e. maxilla with endites, internal view; and f. endites of maxilla, internal view.

pod 2 without ventral seta. Furca with unpaired seta.

3.3 *Description*

Carapace (Figs 1a–c and 7a, b). Carapace smooth without setae and ornamentation (pits or grooves), sub-rectangle in lateral view; shoulder vaults unconspicuous; rostrum subequal anteriorly with acutangular tip, curved downward, wide and developed; antero-ventral margin, postero-dorsal and postero-ventral corner rounded; anterior part slightly higher than posterior part; dorsal margin approximately flat; ventral margin with slightly concavity. Carapace with three groups of glands: one asymmetric gland opening on postero-dorsal corner of left valve, one lateral gland opening on right postero-ventral corner; dense edge glands placed along anterior to posterior ventral margin; postero-ventral corner of left valve without gland. Length 2.33–2.57 mm, height 1.33–1.47 mm, height about 56.5%–57.9% of length.

Frontal organ (Figs 2a, c and 7c, d). Stem and capitulum separated, straight and clavate with blunt tip, small disto-dorsal and ventral spines. Capitate base separated from first antenna.

First antenna (Figs 2a, b, d and 7c). First antenna uniramous. Basale and endopod 1 bare. Endopod 2 with one small dorsal spinose seta. Endopod 3–5 very short and small. Endopod 4 with two ventral sensory setae (a- and b-setae). Endopod 5 blunt con-

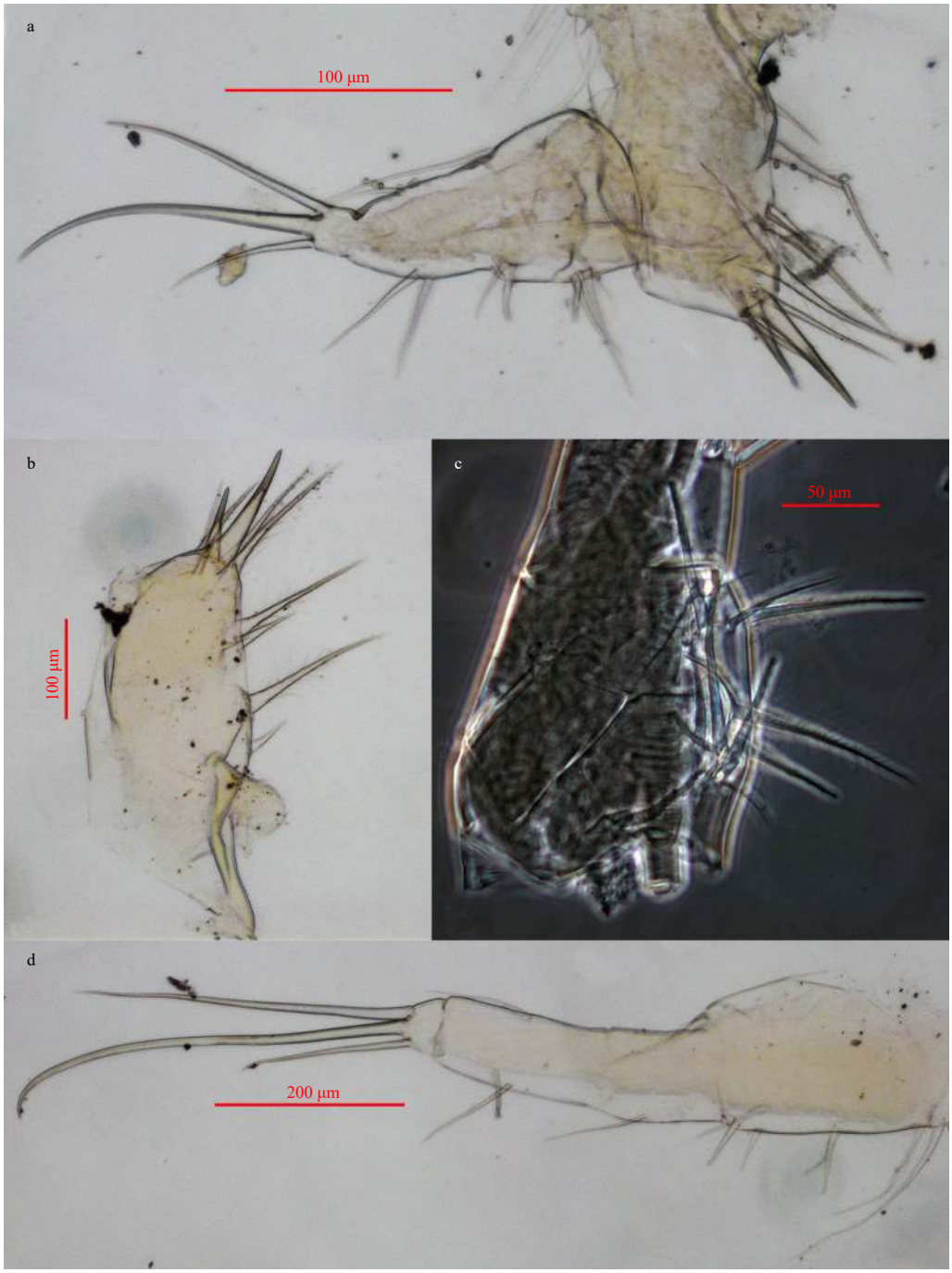

Fig. 5. *Polyconchoecia chenii* sp. nov. (♀). a. Fifth limb, external view; b. endites of fifth limb; c. basale of fifth limb, external view; and d. sixth limb, external view.

ical with three disto-ventral sensory setae (c-, d-, e-setae). A- and c-setae analogic long columnar, thin walled and bare with long end joint; b- and d- setae equilong and bare without end joint, slightly longer than a- and c-setae; e-seta extremely long (approximately one and half length of a-seta) and spinose ventral spines with numerous small ventral spines on distal half.

Second antenna (Figs 2e, f, 3a, b and 7e, f). Limb biramous with large protopodite with powerful muscles. Endopod without c- and d-setae. Endopod 1 large, folded forward, with bend a- and b-setae, a-seta bare and short, b-seta long and spinose, about twice length of a-seta; processus mamillaris normal. Endopod 2 and 3 integrated into a small peg shaped bulge on disto-dorsal margin of endopod 1, with bare 5 setae; g-seta longest and ringed; f-seta second longest; h-, i-, j- setae equilong. Exopod 1 more than seventeen times length of 2, with one bend acerose spine on disto-dorsal margin instead of plumose seta; exopod 2–7 very short with analogous long plumose swimming seta on disto-ventral margin respectively; exopod 8 and 9 fused with one long plumose seta, one shorter plumose seta and one very small seta on tip.

Mandible (Figs 3c–e, 4a–c and 7g–j). Basale large. Exopod tiny peg shaped, with one dorsal plumose seta with bare distal part. Endopod 1 more than two times length of 2, with one disto-ventral seta. Endopod 2 short, with two setae on disto-ventral margin:

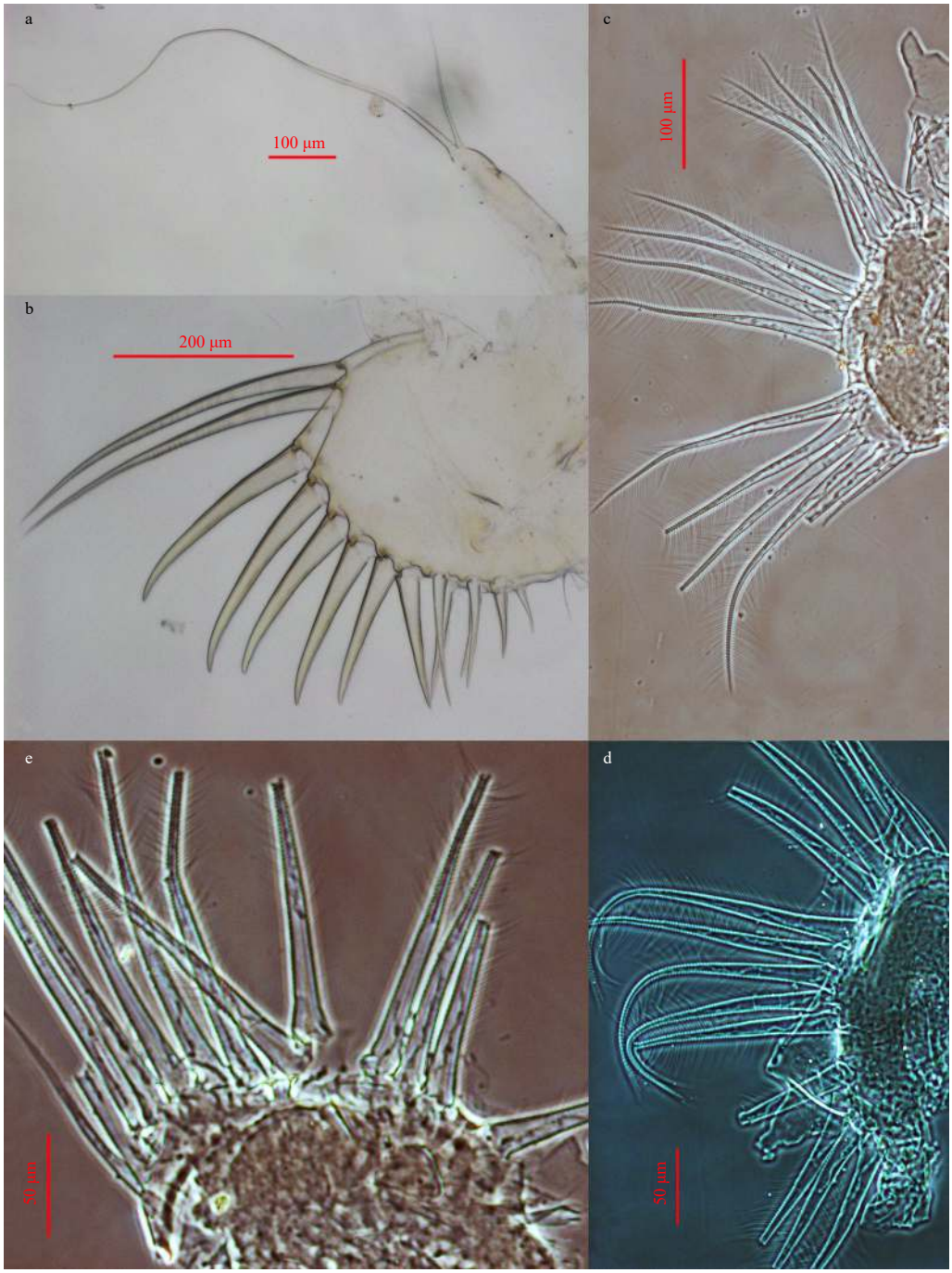

Fig. 6. *Polyconchoecia chenii* sp. nov. (♀). a. Seventh limb, external view; b. furcal lamellae, external view; c epipod of fifth limb, external view; d. epipod of sixth limb, external view; and e. epipod of seventh limb, external view.

outer one bare and short, inner one long with small spines on distal half length; three setae on disto-dorsal edge: mid one short and bare, others long with small ventral spines. Endopod 3 very short, with six setae on tip: seta 1 claw-shaped with distal ventral spines; seta 2 small with ventral spines; seta 3 claw-shaped and biggest with disto-ventral spines; setae 4 and 6 subequal in length; seta 5 about twice length of seta 4. Toothed edge of basale big and triangular with two bare long setae on medio-ventral side and two bare short setae on medio-distal side. Toothed edge of basale with eight distal teeth in one list. Coxal endite constituting by three parts: distal teeth list with one big and bend distal triangular papillae, one big papilla constituted four small teeth, five strip papillae, and one flat papilla; proximal teeth list with small teeth; medial part with some long and big papillae and numerous long cilia.

Maxilla (Figs 4d–f and 8a, b). Exopod with two spinose setae on tip. Endopod 1 big rectangular, with two long and three short bare setae on antero-distal edge, one spinose seta on disto-posterior edge, two long spinose setae on medial side, one long and two short spinose setae on posterior side. Terminal segment with

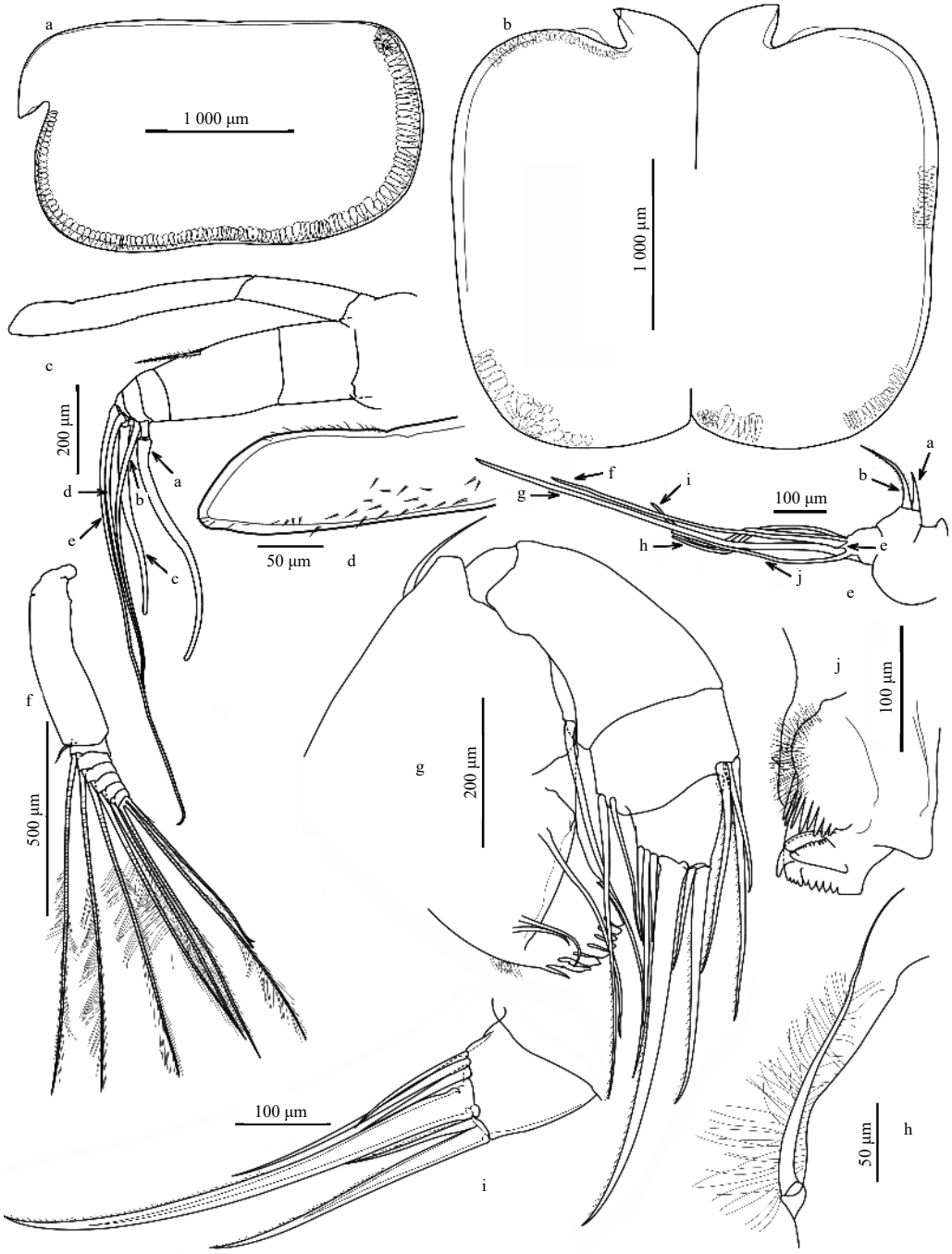

Fig. 7. Line drawings of *Polyconchoecia chenii* sp. nov. (♀). a. Carapace, external view; b. carapace, internal view; c. first antenna and frontal organ, external view; d. tip of frontal organ, external view; e. exopod of second antenna, external view; f. second antenna, external view; g. mandible, internal view; h. exopod of mandible, internal view; i. tip of mandible, internal view; and j. coxal endite of mandible, internal view.

five claws: two bilateral stout spinose claws, two inner puny bare claws and one mid spinose claw; spinose claws with disto-ventral spines. Maxilla with three hirsute endites: endite I with five plumose setae; endite II with one bare and three plumose setae; endite III with ten bare setae.

Fifth limb (Figs 5a–c, 6c and 8c). Limb biramous. Basale large and wide with eleven setae: dorsal seta (vestige of exopod) long and bare; proximal-ventral group of setae with five plumose setae and a pair of symmetric ventral spinose setae; disto-ventral group of setae with one central seta and a pair of symmetric ventral spinose setae. Endopod 1 long with two ventral setae and one dorsal seta; endopod 2 short with three long bare curved claws on tip, mid claw longest, mid and ventral claws with numerous small ventral spines. Coxale with three endites: endite I big rectangular with one short bare and one long plumose proximal setae, one small bare one small plumose and one long plumose distal setae; endite II very short with one long plumose seta; ventral group of setae of endite III with two strong bare and blunt setae, and four sharp plumose setae. Epipod with one small bare inner seta and about sixteen lathy lithe plumose setae.

Sixth limb (Figs 5d, 6d and 8d). Basale broad with one long plumose seta (vesting of exopod), two long proximo-ventral, two short ventral and three short disto-ventral plumose setae; basale without dorso-lateral seta. Exopod 1 short with one ventral seta. Exopod 2 long and thin, with one dorsal and one ventral seta. Terminal segment blunt and very short with three very long acer-

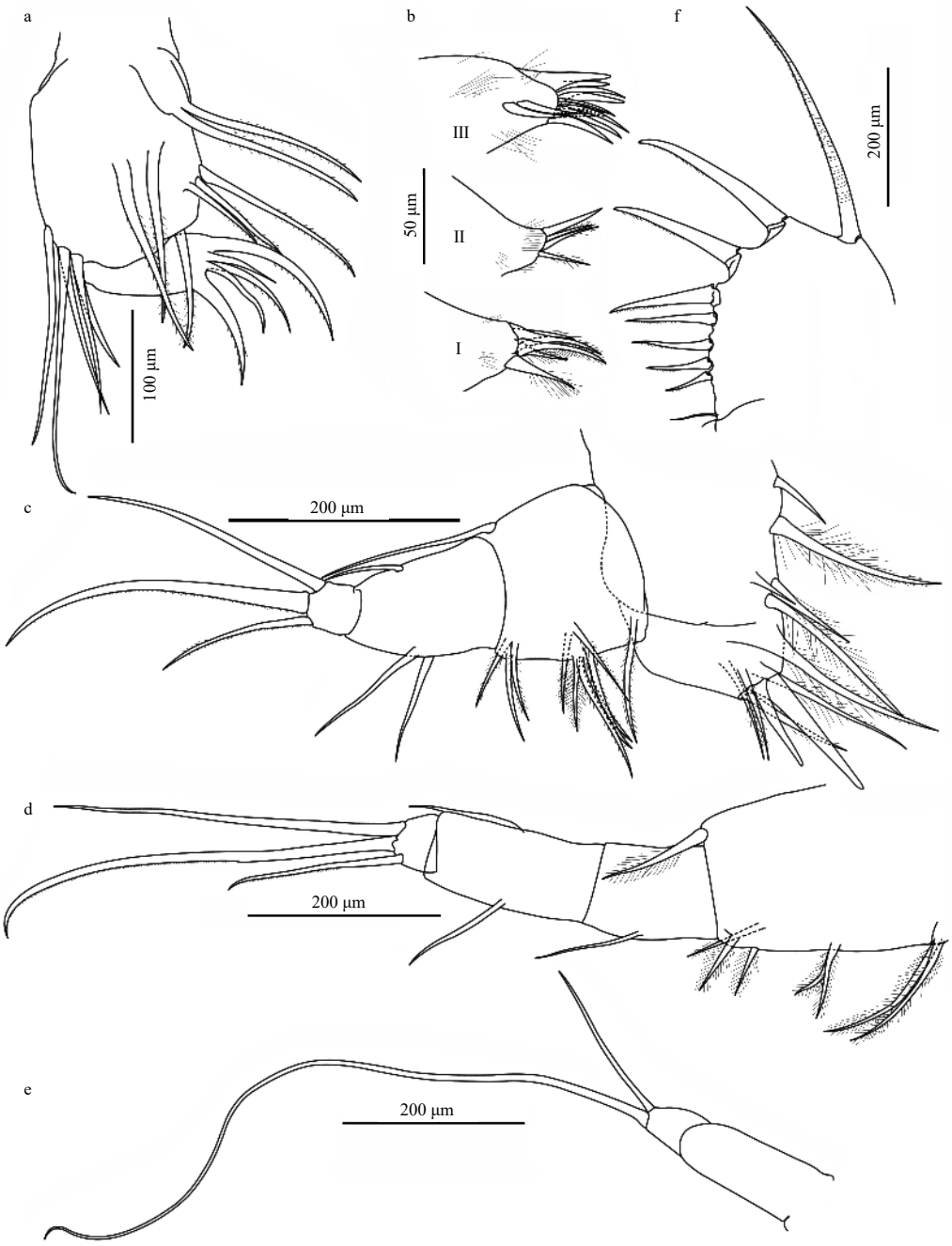

Fig. 8. Line drawings of *Polyconchoecia chenii* sp. nov. (♀). a. Maxilla, internal view; b. endites of maxilla, internal view; c. fifth limb, external view; d. sixth limb, external view; e. seventh limb, external view; and f. furcal lamella, external view.

ose claws on tip; mid claw longest with curved distal part; mid and ventral claws with numerous small disto-ventral spines. Epipod with one small bare inner seta and about seventeen lathy lithe plumose setae.

Seventh limb (Figs 6a, e and 8e). Segment 1 slender and bare. Segment 2 very short conical with one bare long seta and one bare lathy lithe seta (four times length of another) on tip. Epipod with one small bare inner seta and about fourteen lathy lithe plumose setae.

Furca (Figs 6b and 8f). Each furcal lamella with one large dorsal seta and seven claws, from long to short in turn arrangement. Seta and claws with numerous small disto-ventral spines. Furca with ventral unpaired seta.

4 Discussion

These specimens are considered to be one species of the subfamily Conchoeciinae Müller, 1912 of family Halocyprididae Dana, 1853, according to the Chen and Chavtur's diagnosis (Chen and Lin, 1995; Chavtur and Angel, 2011), and then we can put them into the tribe Conchoeciini, Chavtur and Angel, 2011 easily. They are very close to *Polyconchoecia commixtus*, the type species of genus *Polyconchoecia*, which genus has been reported recently and with only one species yet. They have shared characteristics as followed: (1) similar size of full adult; (2) the shapes of carapace are very close; (3) left valve has a left asymmetric gland near postero-dorsal corner; (4) right valve has a lateral gland on right postero-ventral corner; (5) dense edge glands are placed along anterior to posterior ventral margin of carapace in line; (6) exopod 1 of second antenna has one bend acerose spine on disto-dorsal margin instead of plumose seta; (7) the structures of main limbs are similar.

Although these specimens are very close to *P. commixtus*, *P. chenii* sp. nov. is discriminated by the morphological comparisons shown in Table 1. They have obvious and individual distinctions to separate from *P. commixtus*: (1) left asymmetric gland of carapace of the new species is moved posteriorly, the carapace have no right asymmetric gland or compound gland (Figs 1b, c and 7a, b); (2) the frontal organ of this species is separated to stem and capitulum, and has more ventral spines (Figs 2a and 7c, d); (3) in *P. chenii* sp. nov., the seta of endopod 2 of the first antenna is very small; (4) in *P. commixtus*, a- to d-setae of the sensory setae of the first antenna are analogic with long end joint, e-

Table 1. Comparisons between *Polyconchoecia chenii* sp. nov. and *P. commixtus* (♀)

Characteristics		*P. commixtus*	*P. chenii* sp. nov.
Carapace	left asymmetric gland	near postero-dorsal margin, moved anteriorly	on postero-dorsal corner
	right asymmetric gland	on right postero-ventral corner	none
	right lateral gland	constituting a compound gland with right asymmetric gland	only on right postero-ventral corner
Frontal organ	stem and capitulum	fused	separated
	spines	small disto-ventral and mid-ventral spines	small disto-dorsal and ventral spines
First antenna	endopod 2	with one long dorsal plumose seta	with one small dorsal plumose seta
	sensory setae	a- to d-setae analogic, long columnar, thin walled and bare, with long end joint; e-seta bare, with short end joint	a- and c-setae analogic, long columnar, thin walled and bare with long end joint; b- and d-setae analogic, equilong and bare without end joint, slightly longer than a- and c-setae; e- seta spinose, without short end joint
Second antenna	endopod	c-, d-, e-setae absent; b-seta bare; one small oval hump with central concave on mid-ventral margin, instead of processus mamillaris	e-setae present; b-seta spinose; processus mamillaris normal.
	exopod	exopod 1 and 2 fused, exopod 2-4 bare, exopod 8 and 9 separated; terminal plumose seta with single tip	exopod 1 and 2 separated, exopod 2-4 with plumose setae, exopod 8 and 9 fused
Mandible	coxale teeth side	with eight distal teeth	with six distal teeth
	tooth endites	with four tooth plates	with three tooth plates
	endopod	endopod 1 with one ventral seta, and one dorsal seta; endopod 2 with one disto-ventral seta; terminal segment with seven spinose setae	endopod 1 with one ventral seta, without dorsal seta; endopod 2 with two disto-ventral setae; terminal segment with six setae, ventral three bare
Maxilla	endopod	endopod 1 with six disto-anterior setae, one disto-medial seta, none medial seta, and two disto-posterior setae; mid seta of terminal segment bare	endopod 1 with five disto-anterior setae, one disto-medial seta, two medial setae, and three disto-posterior setae; mid seta of terminal segment spinose
	endites	endite I with eleven plumose setae, endite II with ten plumose setae, endite III with eight plumose setae	endite I with five plumose setae; endite II with one bare and three plumose setae; endite III with ten bare setae
Fifth limb	basale	proximal-ventral group of setae with four setae	proximal-ventral group of setae with seven setae
	endopod	endopod 1 with one ventral seta	endopod 1 with two ventral setae
	endites	endite I with one seta; endite II with two setae; endite III with one proximal seta, three sharp and two blunt distal setae	endite I with five setae; endite II with one seta; endite III with none proximal seta, four sharp and two blunt distal setae
Sixth limb	basale	disto-dorsal seta (vesting of exopod) small and bare; three small ventral setae.	disto-dorsal seta (vesting of exopod) strong and spinose; seven ventral plumose setae
	endopod	endopod 1 with one ventral seta; endopod 2 with one ventral seta	endopod 1 bare; endopod 2 without ventral seta
Furca	unpaired seta	no	yes

seta has short end joint; in these specimens, a- and c-setae are analogic with long end joint, b- and d-setae are analogic without end joint, e-seta has no end joint; (5) in *P. commixtus*, the endopod of the second antenna has not c-, d- and e-setae, and one small oval hump with central concave on mid-ventral margin, instead of processus mamillaris; in these specimens, e-seta is present and the processus mamillaris is normal (Figs 2f and 7e); (6) in *P. commixtus*, the exopod 2-4 of the second antenna have no swimming setae (Figs 2e, 3a and 7f); (7) they have unsimilar tooth edge of the coxal endite (Figs 3b, c, 7j and Table 1); (8) they have different setal counts of the mandible, maxilla, fifth limb, and sixth limb (detailed numbers are given in Table 1); (9) *P. chenii* sp. nov. has unpaired seta on the furcal lamella (Figs 6b and 8f).

The ostracod faunae of the South China Sea have been known mainly from plankton surveys in surface water or euphotic zone (0–200 m). The local ostracod diversity of deep environments may equal or exceed that of their epi-pelagic relatives (Gianni, 2004; Danovaro et al., 2008). In these years, there are more and more deep-water species have been discovered and reported (Yin et al., 2014; Tanaka and Yasuhara, 2016; Du et al., 2018; Xiang et al., 2018). This work is the second discovery of the genus *Polyconchoecia* from the world.

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