Animal Cells and Systems
Vol. 15, No. 1, March 2011, 63–72

Taylor & Francis
Taylor & Francis Group

First record of the genus *Cyclopinoides* (Copepoda, Cyclopoida, Cyclopinidae) from the Pacific

Cheon Young Chang*

Department of Biological Science, Daegu University, Gyeongsan 712-714, Republic of Korea

(*Received 24 August 2010; received in revised form 17 November 2010; accepted 18 November 2010*)

A new species belonging to the genus *Cyclopinoides* Lindberg, 1953 (Cyclopinidae) is described from three beaches in Korea and Japan, as the first record of the genus from the Pacific. Among five species currently recognized in the genus, the new species resembles *C. schulzi* Herbst, 1964 from the Red Sea in sharing the character combination of 20-segmented antennule and stumpy caudal rami. However, *C. orientalis* n. sp. differs from it by relatively longer caudal rami (2.5–2.8 times as long as wide in female and about 1.6–1.8 times in male, while less than 2 times in female and about 1.3 times in male of *C. schulzi*), and by the transformation of an outer distal spine to a slender seta on the distal exopodal segment of leg 4. Moreover, *C. orientalis* n. sp. is discernible from *C. schulzi* in having a pyriform copulatory tube (against elongated tubular style in *C. schulzi*). A key to the species hitherto known in the genus is provided.

Keywords: East Asia; marine interstitial Copepoda; meiofauna; new species; taxonomy

Cyclopinid copepods are an important group in the marine epibenthic or interstitial fauna. They are frequently found on beaches and the sublittoral sandy bottom. However, taxonomic study on them is relatively very poor when compared with the case of freshwater cyclopid copepods. Especially, the familial classification of the group is still unclear and controversial, and efforts have been made, particularly with regard to the family Cyclopinidae *s. lat.* The Cyclopinidae *s. lat.* was suspected as paraphyletic (Huys and Boxshall 1991; Martínez-Arbizu 2000a), and recently five new families have been proposed for lots of genera formerly belonging to the family Cyclopinidae *s. lat.* by Martínez-Arbizu (2000b, c, 2001a, b, 2006) (see Boxshall and Halsey 2004: 509–511; Karanovic 2008: 81–84).

Furthermore, even among the remaining genera in the Cyclopinidae *s. str.*, the taxonomic locations of some genera are still in dispute. One of them is the genus *Cyclopinoides* Lindberg, 1953, which is either retained within the family Cyclopinidae *s. str.* (Boxshall and Halsey 2004; Dussart and Defaye 2006) or placed into the family Smirnovipinidae (Walter 2009; Pesce 2010). *Cyclopinodes* Wilson, 1932, a different genus with a similar generic name, has also led to some confusion in the classification of *Cyclopinoides*. For example, some *Cyclopinodes* species such as *C. barentsiana* (= *Smirnovipina barentsiana*), *C. elegans* and *C. elongata* are erroneously listed within the genus *Cyclopinoides* in the World Copepoda database (Walter 2009). Currently, only five species are recognized in the genus, and their distribution is still confined to the Mediterranean, the North Sea and the Red Sea (Pesce 2010).

During field surveys for the marine cyclopoid copepods in East Asia, a new species belonging to the genus *Cyclopinoides* was found at three species-rich beaches, Jeju Island, Guryongpo beach on the southeastern coast of Korea, and Tsushima Island, Japan. As the first record from the Pacific, the new species is fully described herein, and a revised key to species hitherto known in the genus is provided.

Materials and methods

Materials were collected at the three beaches in Korea and Japan (Figure 1). Samples were obtained by scooping the top sediment at the subtidal sandy bottom (about 2–6 meters deep) into polyethylene vinyl bags or 700 ml volume plastic bottles by skin diving. The specimens were filtered in the field through a plankton net of 64 μm mesh after rinsing with freshwater for a few minutes. Copepods were then fixed and stored in 4% buffered formalin.

Specimens were dissected and mounted in lactophenol on H-S slides, a recent variation of the Cobb slide, after treatment in a solution of 10% glycerine/90% ethyl alcohol for 1–2 days. Dissection was conducted using two needles made from 0.5 mm diameter tungsten wire, sharpened by electrolysis (Huys and Boxshall 1991). Mounted specimens were observed using a differential interference contrast microscope (Olympus BX-51)

*Corresponding author. Email: cychang@daegu.ac.kr

ISSN 1976-8354 print/ISSN 2151-2485 online

DOI: 10.1080/19768354.2011.555132
http://www.informaworld.com

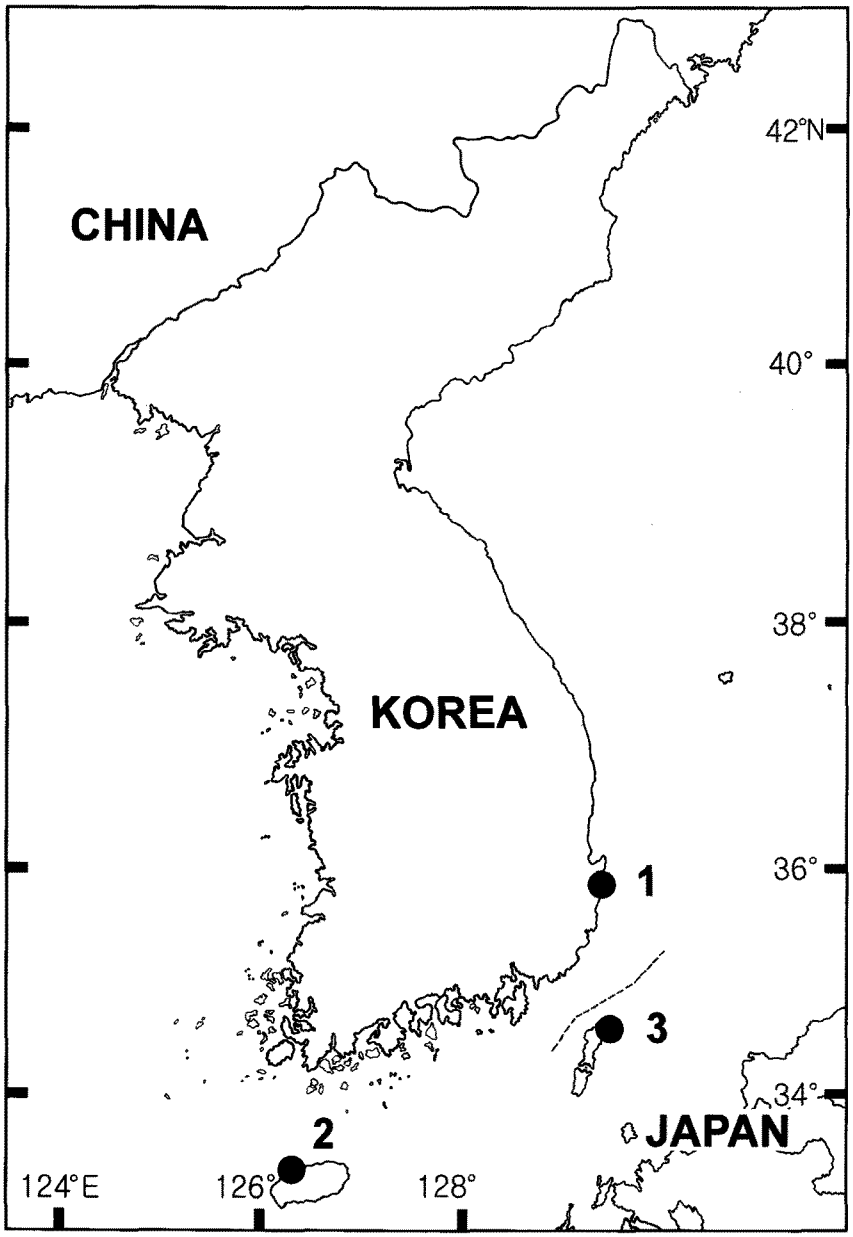

Figure 1. A map showing localities. 1, Guryongpo, Pohang; 2, Aewol, Jeju Island; 3, Miuda, Tsushima Island.

equipped with Nomarski optics. All drawings were made with the aid of a camera lucida.

Measurements were performed using a digital camera for the microscope (Cool SNAP 5.0M, Roper Scientific Co., USA) and the calibration software QCapture Pro (ver. 5.0, Media Cybernetics Inc., USA).

Type specimens have been deposited in the National Institute of Biological Resources (NIBR), Incheon, Korea, and the specimen room of the Department of Biological Science, Daegu University (DB), Korea.

Abbreviations used in the text and the table follow the conventional ones frequently used in the taxonomy of copepods: enp 1–3 or exp 1–3, the first to third endopodal or exopodal segment of each leg.

Systematic accounts

Family Cyclopinidae Sars, 1913

Genus *Cyclopinoides* Lindberg, 1953

Cyclopinoides orientalis n. sp. (Figures 2–5)

Type

Holotype ♀ (NIBRIV0000225850), allotype ♂ (DB20029), undissected in 80% ethyl alcohol, Miuda beach (34° 40′ 05.83″N, 129° 29′ 06.45″E), Tsushima Is., Japan, 17 Jul. 2008 (leg. C.Y. Chang and J.M. Lee). Paratypes: 11♀♀, 1♂, collection details same as in holotype, including 9 undissected females (DB20030)

and 3 dissected paratypes (2♀♀, DB20031, 20032; 1♂, DB 20033); 2♀♀ (NIBRIV0000225851), Samjeong beach (36° 00′ 07.42″N, 129° 34′ 16.1″E), Guryongpo, Pohang, 9 Aug. 2009 (C.Y. Chang and J.M. Lee).

Additional material examined

2♀♀, Gwakji beach (33°26′57.36″N, 126°18′9.48″E), Aewol, Jeju Is., 19 Oct. 1995 (C.Y. Chang and J.M. Lee); 3♀♀ (1 ovi.), Miuda beach, Tsushima Is., Japan, 30 Sep. 2009 (C.Y. Chang and J.M. Lee).

Description

Female

Body (Figure 2A) relately small, 786 ± 32 μm ($n = 9$) in length, excluding caudal seta. Body length/width ratio about 2.4; greatest width at posterior margin of cephalothorax. Color of preserved specimens tinged with pale brown, antennules often in violet hue. Rostrum directed ventrally, not discernible in dorsal view, but triangular with blunt apex in ventral view. Nauplius eye invisible.

Prosome oval, about 1.6 times longer than urosome. Cephalosome somewhat protruding anteriorly, nearly 1.5 times as long as next four thoracic somites combined; several sensilla scattered on dorsal surface. First pedigerous somite divided from cephalosome, nearly concealed beneath posterior extension of dorsal cephalic shield. Hyaline fringe of prosomites narrow and nearly smooth; dorsal surfaces ornamented with minute sensilla and integumental pores; without pronounced lateral expansions.

Length ratio of urosomites, beginning with fifth pedigerous somite, 33: 100: 35: 30: 38. Fifth pedigerous somite slightly broader than genital double somite, ornamented with two dorsal sensilla; posterolateral corner pronounced. Genital double somite (Figure 2B, C) 1.4 times longer than wide, anterior half a little swollen laterally and ventrally, marked by weak lateral notches and cuticular wrinkles dorsolaterally, with one minute slender seta, one bidentate spinous element and one sharp projection, representing leg 6. Copulatory pore located midventrally at about 2/5 of genital somite. Copulatory duct pyriform or ovoid, with heavily sclerotized, thickened wall. Seminal receptacle fully fused medially; both lateral sides divided into two lobes, anterior lobe a little broader than posterior one, forming a butterfly-shape. Posterior margins of all urosomites with narrow, smooth hyaline fringes, except for anal somite with 10–12 spinules along posterior margin ventrally. Anal operculum situated close to anterior margin of anal somite, not strongly convex with smooth posterior margin (Figure 5A).

Caudal rami (Figure 5A) nearly parallel, 2.5–2.8 times as long as wide (ventral view), about 1.4 times longer than anal somite, without hairs along inner (medial) margin. Dorsal pore situated medially at about 1/3 of ramus's length. Lateral caudal seta inserted at about proximal 2/5 of lateral margin of ramus, plumose, slightly longer than ramus. Outer caudal seta (caudal seta III) short and slender, not spiniform, about 0.6 times as long as ramus, about 1/3 as long as inner caudal seta (caudal seta VI), flanking 2–3 spinules laterally. Terminal caudal setae (caudal seta IV, V) with breaking planes, bipinnate. Inner caudal seta (caudal seta VI) well developed, plumose, about 1.7–1.8 times as long as caudal rami, about 3 times longer than outer caudal seta. Dorsal caudal seta (caudal seta VII) plumose, a little shorter (0.8–0.9 times) than inner caudal seta, and apparently longer (1.3–1.4 times) than caudal ramus.

Antennule (Figure 2D) short, exceeding just over half of cephalosome, consisting of 20 segments; sixth to eighth segments not completely divided. Third segment longest, 1.25 times as long as wide. Setal formula: 1-[4], 2-[4], 3-[8], 4-[2], 5-[2], 6-[2], 7-[2], 8-[3], 9-[1], 10-[1], 11-[1], 12-[1], 13-[0], 14-[1], 15-[1], 16-[0], 17-[1], 18-[2], 19-[2], 20-[7 + 1 aesthetasc].

Antenna (Figure 2E) slender, distinctly 4-segmented: coxobasis and 3-segmented endopod. Coxobasis about 2.1 times as long as wide, with one long pinnate seta at inner distal corner; exopodal seta naked, flanking one slender, naked seta inner distally. First endopodal segment about 1.7 times as long as wide, ornamented with several minute spinules on swollen outer (caudal) margin, and one plumose seta at middle of inner margin. Second endopodal segment small, about 1.4 times as long as wide, armed with one short, slender seta at middle of inner margin and three inner distal setae (one naked, one plumose, and one pinnate). Third endopodal segment elongate, about 3.7 times as long as wide, ornamented with one spinule row on outer proximal margin, bearing 6six apical setae including two geniculate and two pinnate setae.

Mandible (Figure 3A) comprising coxa with well-developed gnathobase and distal palp; palp composed of basis with one stout plumose seta medially, 2-segmented endopod with three, six setae, respectively, and 4-segmented exopod with setation of 1,1,1,2. Maxillule (Figure 3B), syncoxa well-developed; basis bearing three and two setae, representing distal basal endites; endopod armed with seven plumose setae; exopod bearing four plumose setae. Maxilla (Figure 3C) 6-segmented (praecoxa and coxa partly fused); praecoxa armed with a group of four setae including a robust one on proximal endite and a pinnate seta representing distal endite; two coxal endites, each bearing three setal elements, distal endite highly mobile; basis forming one strong bipectinate claw flanking one long pinnate and one short

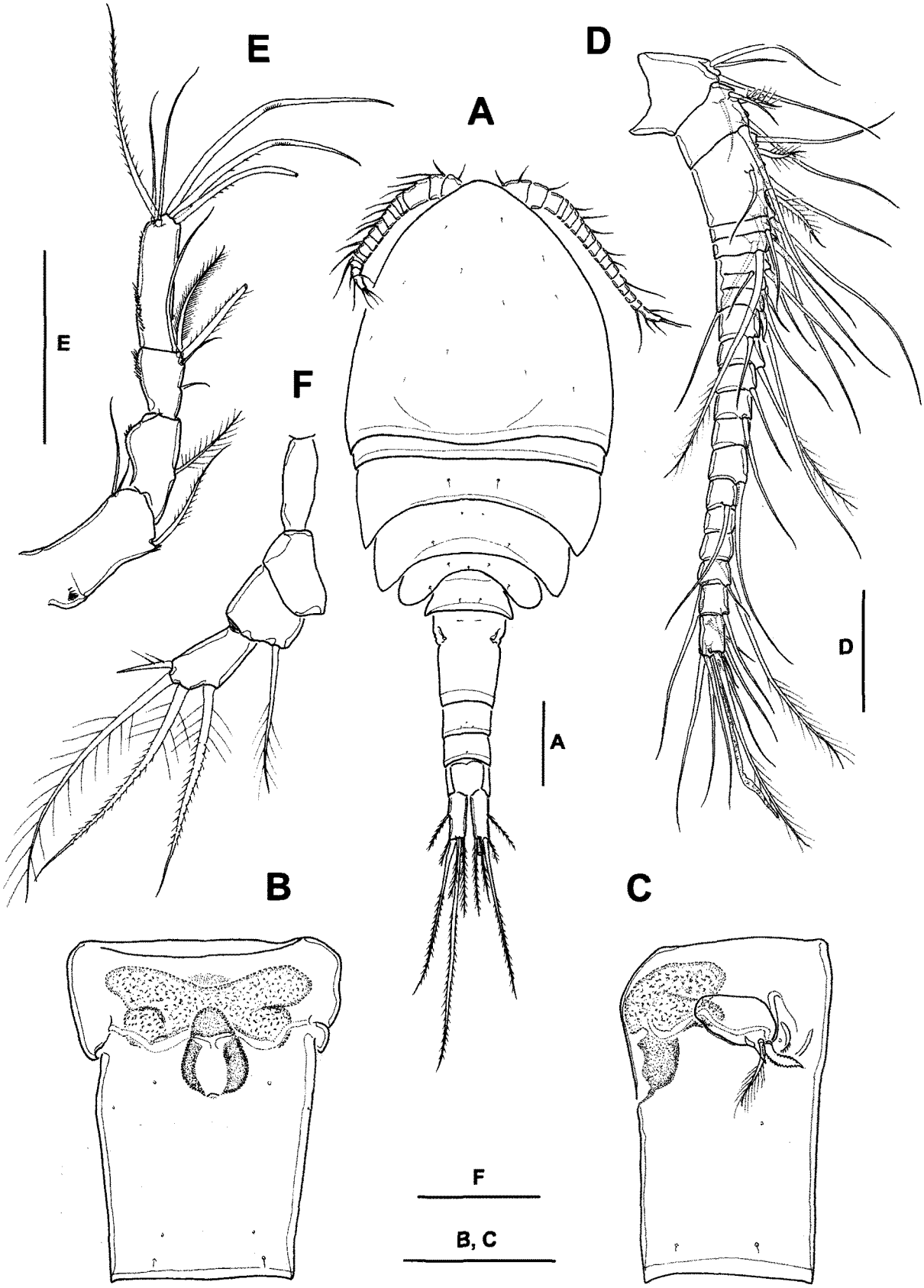

Figure 2. *Cyclopinoides orientalis* n. sp., female. A, habitus, dorsal; B, genital somite, ventral, showing genital apparatus; C, genital somite, lateral (left side); D, antennule; E, antenna; F, leg 5. Scale bars = 100 μm (A) and 50 μm (B–F).

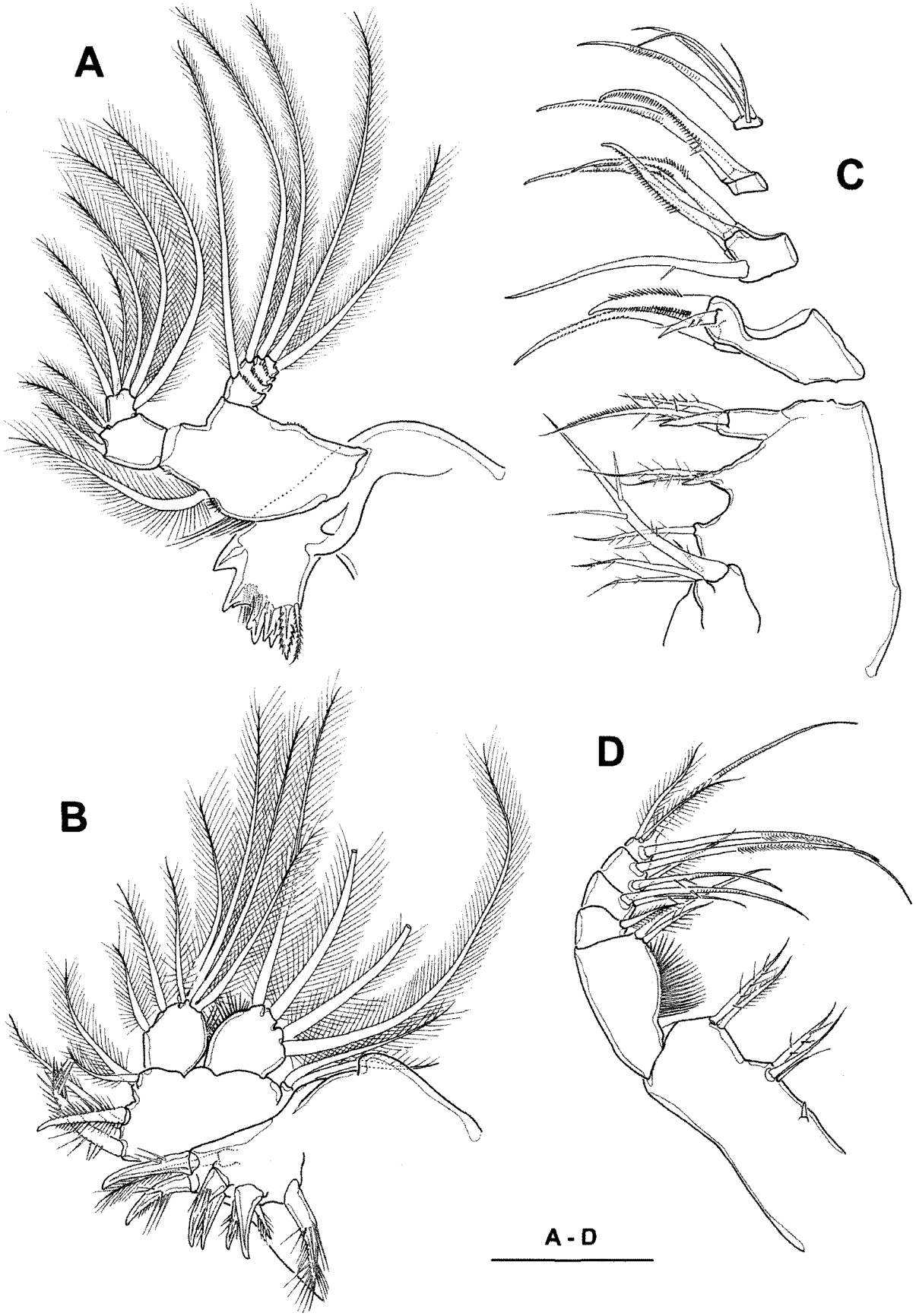

Figure 3. *Cyclopinoides orientalis* n. sp., female. A, mandible; B, maxillule; C, maxilla; D, maxilliped. Scale bar = 50 μm.

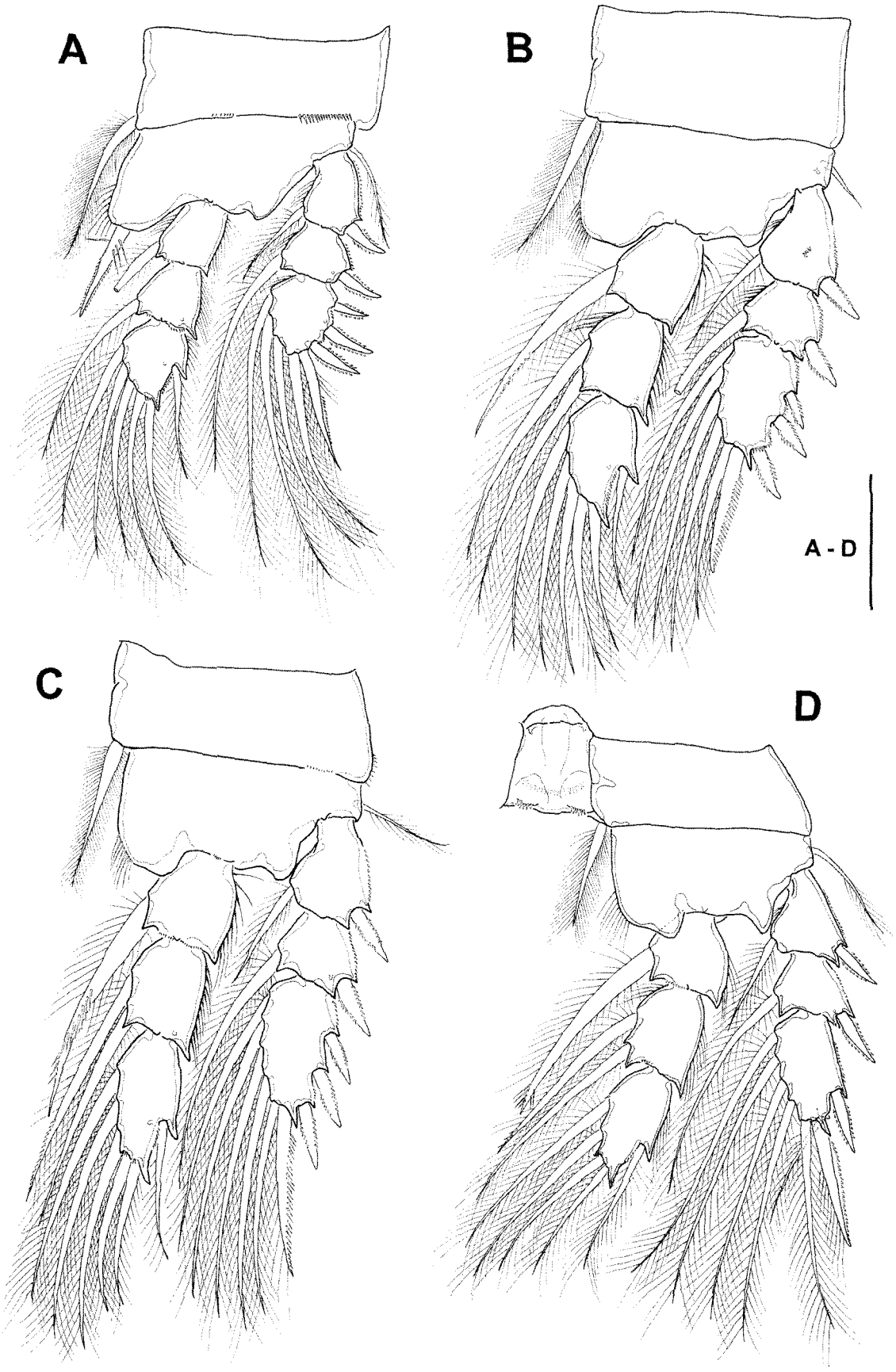

Figure 4. *Cyclopinoides orientalis* n. sp., female. A–D, legs 1–4. Scale bar = 50 μm.

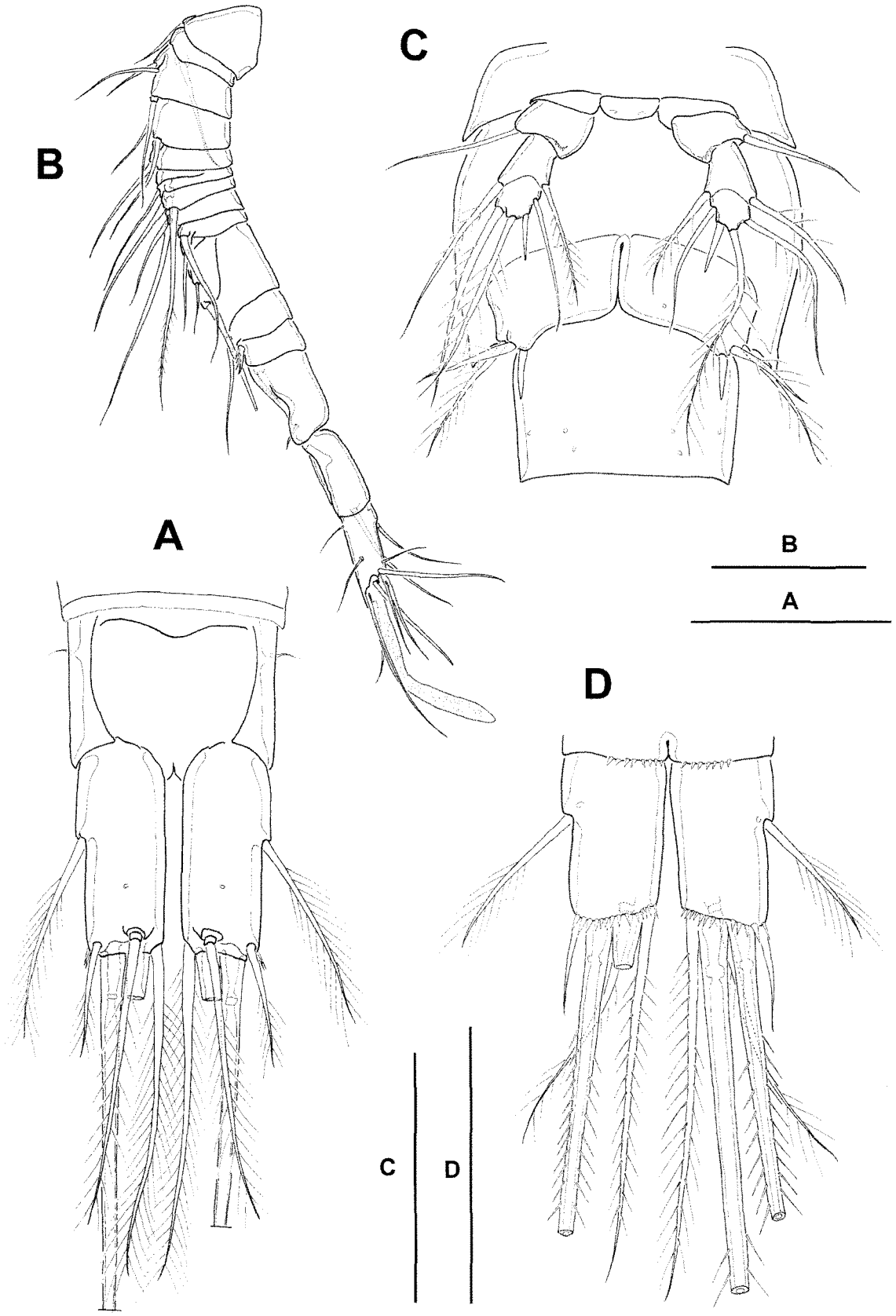

Figure 5. *Cyclopinoides orientalis* n. sp. A, female anal somite and caudal rami, dorsal. B–D, male: B, antennule; C, genital somite and legs 5–6, ventral; D, caudal rami, ventral. Scale bars = 50 μm.

spiniform element basally; endopod 3-segmented, first endopodal segment with four long geniculate setae, second endopodal segment with two stout geniculate setae; distal endopodal segment minute, indistinctly separated from second endopodal segment, with four setae in total. Maxilliped (Figure 3D) slender; syncoxa bearing three and two setae, each representing praecoxal and coxal endites; basis bearing two setae inner distally, with a setule row along swollen medial margin; endopod 4-segmented (penultimate segment incompletely fused) with 1, 2, 2 + 1, 4 setae.

Legs 1–4 swimming legs (Figure 4A–D), biramous, both exopods and endopods 3-segmented. All intercoxal sclerites of legs 1–4 with almost straight, smooth distal margin, each with two lateral lobes ornamented with minute spinules on distal margin; with a transverse setule row in middle of caudal face. Inner seta on enp 1 of legs 2–4 remarkably stout, distal part modified to spiniform. All exopodal segments of legs 1–4 with minute denticles along outer margin. Leg 1 (Figure 4A), with one stout spiniform seta on inner distal corner of basis, reaching to distal margin of enp 2; exp 1 with one inner seta; exp 3 with three outer spines and five setae including one outer distal pinnate seta. Leg 4 (Figure 4D), enp 1 with stout, spinous inner seta; enp 3 1.8 times as long as wide with one outer, two distal, two inner setae; outer distal spine of exp 3 transformed to slender plumose seta. Seta formula (number of setae on exp 3 of legs 1–4, including outer distal spiniform seta) 5,6,6,7. Spine formula (number of spines on exp 3 of legs 1–4) 3,3,3,1. Seta/spine armature of legs 1–4 as follows (Arabic numerals representing setae, while Roman numerals indicating spines):

Leg 1	basis 1–I	exp I-1; I-1; III,2,3	enp 0–1; 0–1; 1,2,3
Leg 2	basis 1–0	exp I-1; I-1; III,2,4	enp 0–1; 0–2; 1,2,3
Leg 3	basis 1–0	exp I-1; I-1; III,2,4	enp 0–1; 0–2; 1,2,3
Leg 4	basis 1–0	exp I-1; I-1; + 1,2,4	enp 0–1; 0–2; 1,2,2

Leg 5 (Figure 2F) with quadrangular intercoxal sclerite, about 3 times wider than long, distal margin slightly convex, unornamented. Each rami composed of three free segments; first segment (coxa) not enlarged laterally, unarmed; middle segment (basis) armed with one plumose seta outer distally, inner margin nearly straight, not ornamented; distal segment about 2 times longer than wide, with one short inner distal spine, one long plumose apical seta, and two outer distal pinnate setae.

Male

Body 683 μm long (allotype). Caudal rami (Figure 5D) about 1.6 times as long as wide, with similar setal armature as in female. Antennule (Figure 5B) 16-segmented, sixth segment not completely fused; articulation between fourteenth and fifteenth segments, armed with cuticular sheath along outer margin; last segment with long and stout aesthetasc distally. Leg 5 (Figure 5C) 4-segmented, with small intercoxal sclerite; first segment without seta; second segment (basis) with outer distal seta; third segment with one inner and one outer distal setae; distal segment indistinctly divided from third segment, pyriform, nearly as long as wide, with two slender inner, one long apical, one outer setae. Leg 6 reduced to operculum with one short inner spine and two plumose setae distally; outer seta about 1.3–1.4 times longer than inner seta.

Etymology

The proposed specific name, *orientalis* (*L.*, meaning 'of the east, oriental'), alludes to the type locality, the Far East.

Ecology

All three beaches where this new species occurred are situated on open coast, and both sides are fringed with rocks. Specimens were obtained by rinsing the sublittoral fine sand sediments. This species co-occurred with other interstitial ones: *Cerconeotes japonicus* (Ito, 1968), *Cyclopina* spp. (Copepoda), *Tetranchyroderma hetrotentaculatum* Chang and Lee, 2001, *T. hoonsooi* Chang and Lee, 2001, *Ptychostomella orientalis* Lee and Chang, 2003, *Lepidodasys* spp. (Gastrotricha), and *Zelinkaderes* sp. (Kinorhyncha).

Remarks

In the genus *Cyclopinoides* Lindberg, 1953, five species are currently recognized: *C. littoralis* (Brady, 1872), *C. longicornis* (Boeck, 1872), *C. dilatata* (Sars, 1921), *C. bisetosa* (Grandori, 1926), and *C. schulzi* Herbst, 1964. As shown in Table 1, *C. orientalis* n. sp. is distinguished from the congeners by the character combination of 20-segmented antennules, rather short caudal rami (length to width ratio of about 2.5 in female), three outer spines on leg 1 exp 3, and transformation of outer distal spine to a slender seta on leg 4 exp 3.

The four congeners except *C. schulzi* share the transformation of outer distal spine to a slender seta on leg 4 exp 3 with *C. orientalis*. Among them, two European species, *C. longicornis* and *C. dilatata*, are obviously discernible from the new species in showing different antennular segmentation (18- and 19-segmented, respectively) and much elongated caudal rami (more than 4 times as long as wide), although both were insufficiently and inadequately described, not

Table 1. Character comparison of *Cyclopinoides orientalis* n. sp. with the congeneric species.

	littoralis	*longicornis*	*dilatata*	*bisetosa*	*schulzi*	*orientalis* n. sp.
Antennule, number of segments	18	18	19	18	20	20
L/W ratio of caudal rami ♀	2.5–7* ~ 4**	6–8	~4	4–4.5	1.55–1.84	2.5–2.8
♂	2.7–3**	–	–	~ 3	1.3	1.6–1.8
Number of setae/ spines on leg 1 exp 3	5/3	5/3	5/3	4/4	5/3	5/3
Number of setae plus spines on leg 4 exp 3	8	8	8?	8	7	8
Outer distal spine of leg 4 exp 3	transformed to a slender seta	transformed to a slender seta	–	transformed to a slender seta	disappeared	transformed to a slender seta
Locality	England (Brady 1872, 1878); Germany, Norway, Italy (*Giesbrecht 1900); Mozambique (Wells 1967); Black Sea (**Monchenko 1977)	Europe (Boeck 1872; Sars 1913)	Norway (Sars 1921)	Italy (Grandori 1925)	Red Sea (Herbst 1964)	present study

revealing male characters. *Cyclopinoides bisetosa* from Italy is characterized by the seta/spine armature of leg 1 exp 3, that is, four setae and four spines (against five setae and three spines in the congeners including *C. orientalis*) (see Grandori 1926, fig. 43).

Cyclopinoides littoralis is widely distributed in the North Sea (Brady 1872, 1878; Sars 1921; Giesbrecht 1900), the Mediterranean (Giesbrecht 1900), Black Sea (Monchenko 1977) and western Indian Ocean (Wells 1967). It differs from *C. orientalis* by 18-segmented antennule and relatively elongated caudal rami, although Giesbrecht (1900) reported the vast variability in the length to width ratio of caudal rami, ranging 2.5–7, and incomplete fusion of antennular segments. According to the relatively recent redescription of Monchenko (1977), he measured the length to width ratio of caudal rami of about 4 in female and 2.7–3 in male, and illustrated some faint traces of segmentation between the segments 8–10 of antennule (see Monchenko 1977, fig 3–1). Nevertheless, some discrepancy exists between *C. littoralis* and *C. orientalis*, for *C. orientalis* shows consistently short caudal rami (2.5–2.8 times as long as wide in female and 1.6–1.8 in male) and much clearly 20-segmented antennules. Moreover, based on Giesbrecht's (1900) and Mochenko's (1977) figures, *C. orientalis* differs from *C. littoralis* by much elongated inner caudal setae (1.7–1.8 times as long as caudal rami and about 3 times longer than outer caudal seta, while shorter or at best slightly longer than caudal rami and much less than 2 times longer than outer caudal seta in *C. littoralis*).

Cyclopinoide schulzi from the Red Sea resembles the present new species in possessing 20-segmented antennules and stumpy caudal rami. However, *C. schulzi* is different from the new species by much shorter caudal rami (much less than 2 times in female and about 1.3 times as long as wide in male). Moreover, *C. schulzi* is characterized by the disappearance of an outer distal spine on leg 4 exp 3 (see Herbst 1964, fig. 3d), while the outer distal spine is transformed to a curved, slender seta in *C. orientalis* (cf. Figure 4D), as in other congeners. In the Cyclopinidae, the evolutionary trend in genital structure comprises the fusion of paired seminal receptacles, median copulatory pore connected to the sclerotized copulatory duct, and lateral migration of gonopores linked with leg 6 (Huys and Boxshall 1991: 193–194). *Cyclopinoides schulzi* reflects the general features well (see Huys and Boxshall 1991, fig. 2.8.28B, C), as does *C. orientalis*. However, they are evidently discernible from each other in the shape of the copulatory duct, which is apparently pyriform in *C. orientalis*, while simply tubular in *C. schulzi*. The free first pedigerous somite separated from cephalosome, which Herbst (1964) indicated as discriminating *C. schulzi* from other congeners, is shared with the present new species. However, as the first pedigerous somite separated from cephalosome is often overlaid with the posterior extension of dorsal cephalic shield in the ancestral group of Cyclopinidae, it is uncertain whether the discrepancies are derived from the genuine differences between the two species and the other congeneric species, or from the simple incorrect observations and inadequate depictions made in the earliest publications.

A key to the species of genus *Cyclopinoides*

1. Antennules of less than 19 segments; caudal rami elongate, generally much more than 3 times as long as wide in female 2
   —Antennules of 20 segments; caudal rami stumpy, usually much less than 3 times as long as wide in female 5
2. Antennules 18-segmented in female 3
   —Antennules 19-segmented in female . *C. dilatata*
3. Caudal rami 6–8 times longer than wide in female . . . . . *C. longicornis*
   —Caudal rami generally 3–4.5 times longer than wide in female. 4
4. Leg 1 exp 3 with three spines and five setae . . . . . *C. littoralis*
   —Leg 1 exp 3 with four spines and four setae . . . . . *C. bisetosa*
5. Caudal rami less than 2 times as long as wide in female; outer distal spine of leg 4 exp 3 completely disappeared . . . . . *C. schulzi*
   —Caudal rami 2.5–2.8 times as long as wide in female; outer distal spine of leg 4 exp 3 transformed to a slender seta . . . . . *C. orientalis* n. sp.

Acknowledgements

I am obliged to Dr. Ji Min Lee (Daegu University, Korea) for her help in preparing the illustrations, and to Dr. Chad. Walter (The National Museum of Natural History, Smithsonian Institution, USA) for providing references. I also appreciate the two anonymous reviewers for their critical comments, which greatly improved the manuscript. This work was supported by the Korea Research Foundation Grant funded by the Korean Government (MOEHRD, Basic Research Promotion Fund) (KRF-2008-313-C00814) and by the project on survey and excavation of Korean indigenous species of the National Institute of Biological Resources (NIBR) under the Ministry of Environment, Korea.

References

Boeck A. 1872. Nye Slaegter og Arter af Saltvands-Copepoder. Forhandl Vidensk-Selsk Christ. 1872:35–60.

Boxshall GO, Halsey SH. 2004. An introduction to copepod diversity, Vol. I. London: The Ray Society. p. 1–421.

Brady GS. 1872. Contributions to the study of the Entomostraca. No. VII. A list of the non-parasitic marine Copepoda of the north-east coast of England. Ann Mag Nat Hist. 4(10):1–17.

Brady GS. 1878. A monograph of the free and semi-parasitic Copepoda of the British Islands, Vol. 1. London: The Ray Society. p. 1–148.

Dussart BH, Defaye D. 2006. World directory of Crustacea Copepoda of inland waters. II-Cyclopiformes. Leiden: Backhuys Publishers. p. 1–354.

Giesbrecht W. 1900. Mittheilungen über Copepoden 12–14. Mitth Zool Stat Neapel. 14(1):39–82.

Grandori R. 1925. Nuove specie di Copepodi della Laguna Veneta. Boll Ist Zool. R Univ Roma. 3:38–70.

Herbst HV. 1964. Cyclopoida Gnathostoma (Crustacea Copepoda) aus dem Litoral und Küstengrundwasser des Roten Meeres. Kieler Meeresf. 20:155–169.

Huys R, Boxshall GA. 1991. Copepod Evolution. London: The Ray Society. p. 1–468.

Karanovic T. 2008. Marine Interstitial Poecilostomatoida and Cyclopoida (Copepoda) of Australia. Crustaceana Monographs, 9. Leiden: Brill. p. 1–336.

Martínez-Arbizu P. 2000a. The paraphyly of Cyclopinidae Sars, 1913, and the phylogenetic position of poecilostome families within Cyclopoida Burmeister, 1835 (Copepoda: Crustacea) [Ph.D. dissertation]. Germany: University of Oldenburg.

Martínez-Arbizu P. 2000b. Giselinidae fam. nov., a new monophyletic group of cyclopoid copepods (Copepoda, Crustacea) from the Atlantic deep sea. Helgoland Mar Res. 54(4):190–212.

Martínez-Arbizu P. 2000c. A new species of *Cyclopetta* from the Laptev Sea (Arctic ocean), with the recognition of Cyclopettidae fam. nov., a new monophylum of free-living Cyclopoida (Copepoda). Bull Inst Roy Sci Natur BelgBiol. 70:91–101.

Martínez-Arbizu P. 2001a. Hemicyclopinidae n. fam., a new monophyletic group of marine cyclopinid Cyclopoida, with description of one new genus and two new species (Crustacea, Copepoda, Cyclopoida). Senck Biol. 81(1–2):37–54.

Martínez-Arbizu P. 2001b. Psammocyclopinidae fam. n., a new monophyletic group of marine Cyclopoida (Copepoda, Crustacea), with the description of Psammocyclopina georgei sp. n. from the Magellan Region. Rev Brasil Zool. 18(4):1325–1339.

Martínez-Arbizu P. 2006. Phylogenetic relationships within Schminkepinellidae fam. n., a new monophyletic group of marine cyclopinids (Cyclopoida: Copepoda), description of two new genera and four new species. Zoologiya Bespozvonochnykh. 3(2):185–207.

Monchenko VI. 1977. On two Cyclopinidae (Crustacea, Copepoda) from interstitial biotope of the Black Sea. Biologiya Morya. Vladivostok. 1977(5):16–23.

Pesce GL. 2010. Smirnovipinidae. Accessed through: Copepod Web Portal at http://www.luciopesce.net/copepods/smirno3.htm on 2010–08–11.

Sars GO. 1913. Copepoda Cyclopoida. Parts I & II. Oithonidae, Cyclopinidae, Cyclopidae (part). An account of the Crustacea of Norway (Vol. 6). Bergen Museum. p. 1–32.

Sars GO. 1921. Copepoda supplement. Parts IX & X. Harpacticoida (concluded), Cyclopoida. An account of the Crustacea of Norway (Vol. 7). Bergen Museum. p. 93–121.

Walter TC. 2009. Smirnovipinidae. In: Walter TC, Boxshall G, editors. World Copepoda database. Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p = taxdetails&id = 345976 on 2010-08-11.

Wells JBJ. 1967. The littoral Copepoda (Crustacea) of Inhaca Island, Mozambique. Trans Roy Soc Edinburgh. 67(7):189–358.