



BRILL

Crustaceana 96 (1) 87-96

CRUSTACEANA



A NEW SPECIES OF *PARAPHOXUS* (AMPHIPODA, PHOXOCEPHALIDAE) FROM JEJU ISLAND, KOREA

BY

MYUNG-HWA SHIN¹⁾

Department of Biodiversity, National Marine Biodiversity Institute of Korea, Seocheon 33662,
South Korea

ORCID iD: Shin: 0000-0003-1000-856X

ABSTRACT

During a scientific survey, a new species of phoxocephalid amphipod, *Paraphoxus jejuensis* sp. nov., was found in the tidal flat of Jeju Island, Korea. *Paraphoxus jejuensis* sp. nov. is distinguished from its congeneric species by the following features: the presence of a conical-form of incisor on the right mandible, an expanded and subovate basis of pereopod 5, the presence of a single plumose facial seta on epimeron 2, the presence of a few baso-facial setae on the peduncle of uropod 1, the absence of marginal spines and setae on the rami of uropod 2, and the presence of two subapical spines on each lobe of the telson. This new species is described and illustrated herein.

Key words. — Amphipoda, Phoxocephalidae, *Paraphoxus*, new species, taxonomy, Korea

RÉSUMÉ

Au cours d'une étude scientifique, une nouvelle espèce d'amphipode Phoxocephalidae, *Paraphoxus jejuensis* sp. nov., a été trouvée dans la zone de marée de l'île de Jeju, Corée. *Paraphoxus jejuensis* sp. nov. se distingue des espèces congénériques par les caractères suivants : la présence d'une incisive de forme conique sur la mandibule droite, d'un basis élargi et sub-oval du périopode 5, la présence d'une unique soie faciale plumeuse sur l'épiméron 2, la présence de quelques soies baso-faciales sur le pédoncule de l'uropode 1, l'absence d'épines et de soies marginales sur les rames de l'uropode 2, et la présence de deux épines sub-apicales sur chaque lobe du telson. Cette nouvelle espèce est décrite et illustrée ici.

Mots clés. — Amphipoda, Phoxocephalidae, *Paraphoxus*, nouvelle espèce, taxonomie, Corée

¹⁾ e-mail: speciosus@mabik.re.kr; speciosusshin@gmail.com

INTRODUCTION

Members of the family Phoxocephalidae Sars, 1891, one of the fossorial amphipod groups, have been known exclusively as sediment-burrowing species. The Phoxocephalidae contain 81 genera and over 375 species (Horton et al., 2022). Its members have morphological features for fossorial adaptation on the rostrum, antennae, pereopods, pleopods and uropods. They are known to live in habitats ranging from shallow coastal waters to deeper shelf waters in the world (Barnard & Drummond, 1978; Barnard & Karaman, 1991; Jarrett & Bousfield, 1994; Senna, 2010; Shin et al., 2015).

The genus *Paraphoxus* was established by G. O. Sars in 1891 with the type species, *P. oculatus* (G. O. Sars, 1879) occurring in the North Atlantic. Most members of this genus have been recorded from the North Pacific, subarctic and boreal coastal waters (Jarrett & Bousfield, 1994). This genus is currently characterized by the following features: rostrum fully hooded; eyes pigmented; article 1 of antenna 2 not ensiform; article 4 of antenna 2 having stout spines on the distal margin; mandibular molar non-tritulative, bearing 2-4 (usually 3) basally fused spines; inner plate of maxilla 1 having 2 setae, palp 2-articulate; gnathopods 1 and 2 subchelate, similar in size and shape, carpi free, and palms oblique; carpi of pereopods 3 and 4 having 1-2 long stout spines (usually 1) on posterodistal corner; peduncle of uropod 1 bearing baso-facial setae; outer ramus of uropod 3 being 2-articulate, longer than inner ramus in female, terminal article bearing 2 apical setae; telson longer than broad, completely cleft, with apical spines on each lobe (Barnard & Drummond, 1978; Barnard & Karaman, 1991; Jarrett & Bousfield, 1994). Up to now, *Paraphoxus* consists of 12 species: *P. beringiensis* Jarrett & Bousfield, 1994, *P. communis* Jarrett & Bousfield, 1994, *P. gracilis* Jarrett & Bousfield, 1994, *P. latipes* Ren & Huang, 1991, *P. lincolni* G. Karaman, 1988, *P. oculatus* (G. O. Sars, 1879), *P. pacificus* Jarrett & Bousfield, 1994, *P. pyripes* K. H. Barnard, 1930, *P. rugosus* Jarrett & Bousfield, 1994, *P. similis* Jarrett & Bousfield, 1994, *P. simplex* (Gurjanova, 1938), and *P. tomiokaensis* Hirayama, 1987.

Recently, a few specimens of the genus *Paraphoxus* were collected from tidal flats of Jeju Island, Korea. They were confirmed as an unknown member of the genus. In the present study, they are presented as a new species, *Paraphoxus jejuensis*, which is described and illustrated herein. This is the first record of *Paraphoxus* in Korea.

MATERIAL AND METHODS

Materials were collected, using a grab and a light trap, from the sandy bottom of tidal flats of Jeju Island, Korea, between 2004 and 2017. Specimens were preserved

in 90% ethanol. Glycerol and lactic acid were used as the medium for dissection and mounting. Observation and pencil drawings were made using a drawing tube or camera lucida. Body length was measured along the intestinal line from the tip of the rostrum to the posterior end of urosomite 3. The type material of the new species is deposited at the National Marine Biodiversity Institute of Korea (MABIK).

TAXONOMY

Family PHOXOCEPHALIDAE G. O. Sars, 1891

Genus *Paraphoxus* G. O. Sars, 1891

Paraphoxus jejuensis sp. nov. (figs. 1-3)

Material examined.— Holotype: female (3.28 mm, MABIK CR00253039), collected from Jongdal-ri, Gujwa-eup, Jeju-si, Jeju-do, Korea (33°28'56.53"N 126°54'50.78"E), 30 July 2004. Paratypes: 1 female (3.02 mm, MABIK CR00253040), same data as holotype; 1 female (3.34 mm, MABIK CR00253041), collected from Pyeongdae beach, Gujwa-eup, Jeju-si, Jeju-do, Korea (33°32'21.95"N 126°50'17.45"E), 12 May 2017.

Diagnosis.— Antenna 2, peduncular article 4 with 5 stout distal spines; mandible, molar with 3 clumped spines, and article 3 of palp with only apical setae; maxilla 1, outer plate with 9 teeth; gnathopods 1 and 2, propodi about 2 times as long as width, palms oblique; pereopods 3 and 4, carpi with single stout posterodistal spine (not extending to propodi); pereopod 5, basis expanded, posteroventral lobe reaching beyond ischium and rounded; epimeron 2 with single plumose facial seta; epimeron 3 produced backward, posterior margin gently rounded ventrally; uropod 1, peduncle with baso-facial setae; uropod 2, rami without marginal spines; uropod 3, inner ramus long, reaching beyond half of outer ramus; each lobe of telson with 2 weak subapical spines.

Description.— Based on holotype female, 3.28 mm (fig. 1A). Head (fig. 1B, C) about 18% of body length. Rostrum fully formed, not constricted, reaching beyond peduncular article 1 of antenna 1, hood-like. Eyes oval, enlarged.

Antenna 1 (fig. 1D), subequal to head in length; peduncular article 1 stout, about 2 times length of article 2, weakly produced dorsoapically; article 2 about 1.3 times length of article 3, with 3 stout ventrodiscal setae; primary flagellum 5-articulate; accessory flagellum 3-articulate. Antenna 2 (fig. 1E), peduncular article 1 not ensiform; article 4 longer than article 5, with 3 robust facial setae and anterodistal row of 5 robust setae; article 5 about 0.7 times length of article 4; flagellum 7-articulate.

Upper lip (fig. 1F), broad, subrounded ventrally. Lower lip (fig. 1J) inner plate well developed; outer plate with 1 gland-cone and 3 thick-ended setae; mandibular process, obliquely extended.

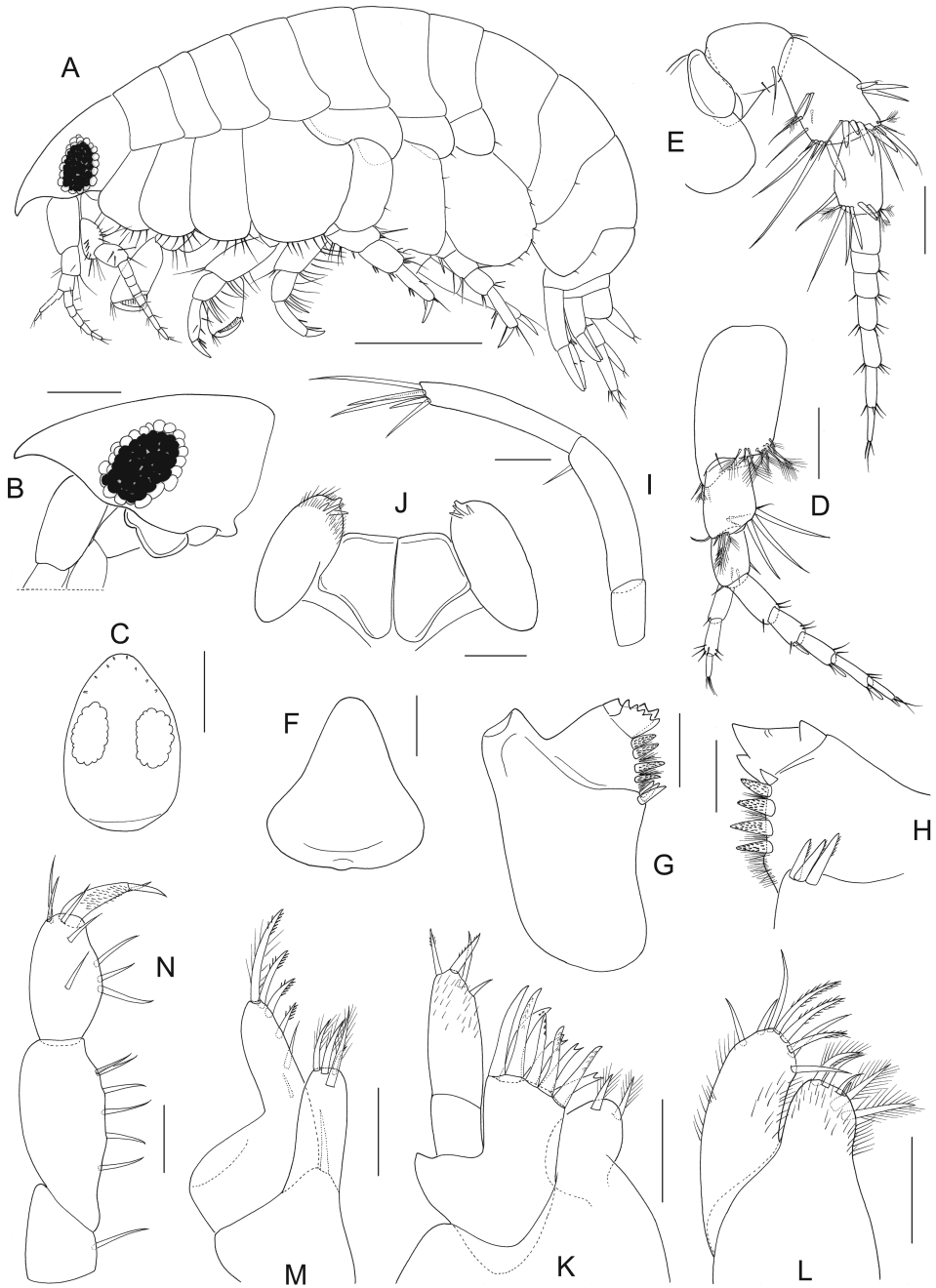


Fig. 1. *Paraphoxus jejuensis* sp. nov., holotype female. A, Habitus; B, head; C, head, dorsal; D, antenna 1; E, antenna 2; F, upper lip; G, left mandible; H, right mandible; I, palp of mandible; J, lower lip; K, maxilla 1; L, maxilla 2; M, maxilliped; N, palp of maxilliped. Scale bars: A = 0.5 mm; C, H = 0.3 mm; B = 0.2 mm; D-E = 0.1 mm; F-G, I-N = 0.05 mm.

Left mandible (fig. 1G), incisor with 3 teeth; lacinia mobilis with 5 teeth; raker low, with 4 finely pectinate spines; molar not triturative, with 3 clumped, long spines. Right mandible (fig. 1H), incisor with 3 teeth; lacinia mobilis simple, single conical-tooth; raker low, with 4 finely pectinate spines; molar simple, with 3 clumped, long spines. Mandibular palp (fig. 1I), thin, 3-articulate; article 1 short, about 0.4 times length of article 2; article 2 as long as article 3, with 1 short inner distal seta; apex of article 3 oblique, with 5 setae.

Maxilla 1 (fig. 1K), inner plate ovate, with 2 long plumose setae; outer plate with 1 simple, 3 bifid, and 5 serrate teeth; palp bi-articulate, extending beyond end of outer plate, with 2 apical and 2 sublateral setae.

Maxilla 2 (fig. 1L), inner plate much shorter than outer, with 4 apical and 2 apicomedial (3 pinnate and 3 simple) setae; outer plate with 1 apicomedial, 1 lateral, and 6 apical (3 serrate and 3 simple) setae.

Maxilliped (fig. 1M), inner plate with 1 mediofacial and 3 apical setae, with 1 basal seta; outer plate reaching middle of palp article 2, with 1 apical (pinnate), 2 apicomedial (serrate) and 3 medial (1 serrate and 2 simple) setae. Maxillipedal palp (fig. 1N), article 1 about 0.5 times length of article 2, with 1 basomedial seta; articles 2-3 with long and short setae on medial margins; article 3 shorter than article 2, not strongly protuberant, with 2 facial setae; article 4 slightly shorter than article 3, apical nail present, distinct.

Gnathopods 1-2 similar, not cryptic. Gnathopod 1 (fig. 2A), coxa 1 expanded distally, with 1 short anterovental and 6 long ventral setae; basis about 0.9 times length of coxa, with 2 long posterior setae; ischium about 0.3 times length of basis; merus slightly shorter than carpus; carpus triangular, about 0.5 times length of propodus, with 2 midventral setae; propodus ovato-rectangular, elongate, about 2 times as long as width; palm oblique, defined by distinct tooth with single robust spine; dactylus falcate, hooded, fitting inner side of posterodistal edge.

Gnathopod 2 (fig. 2B), coxa 2 weakly expanded distally; ischium about 0.7 times length of merus, with 1 long posterodistal seta; merus as long as carpus; carpus triangular, about 0.5 times length of propodus; propodus elongate, about 2 times as long as width; palm oblique, defined by distinct tooth with a robust spine; dactylus falcate, hooded, other features same as in gnathopod 1.

Pereopods 3-4 similar. Pereopod 3 (fig. 2C), coxa subrectangular, with 1 short anterovental and 6 long ventral setae; basis about 3.5 times length of ischium, with 2 posterior and 3 posterodistal setae; merus produced anterodistally, about 2 times length of carpus; carpus short, slightly longer than broad, provided with 1 slightly short stout spine (reaching two-thirds of propodus) and 1 long seta at posterodistal corner; propodus narrow, longer than carpus, with 1 pair of 2 stout spines at posterodistal end; dactylus slender, about 0.5 times length of propodus.

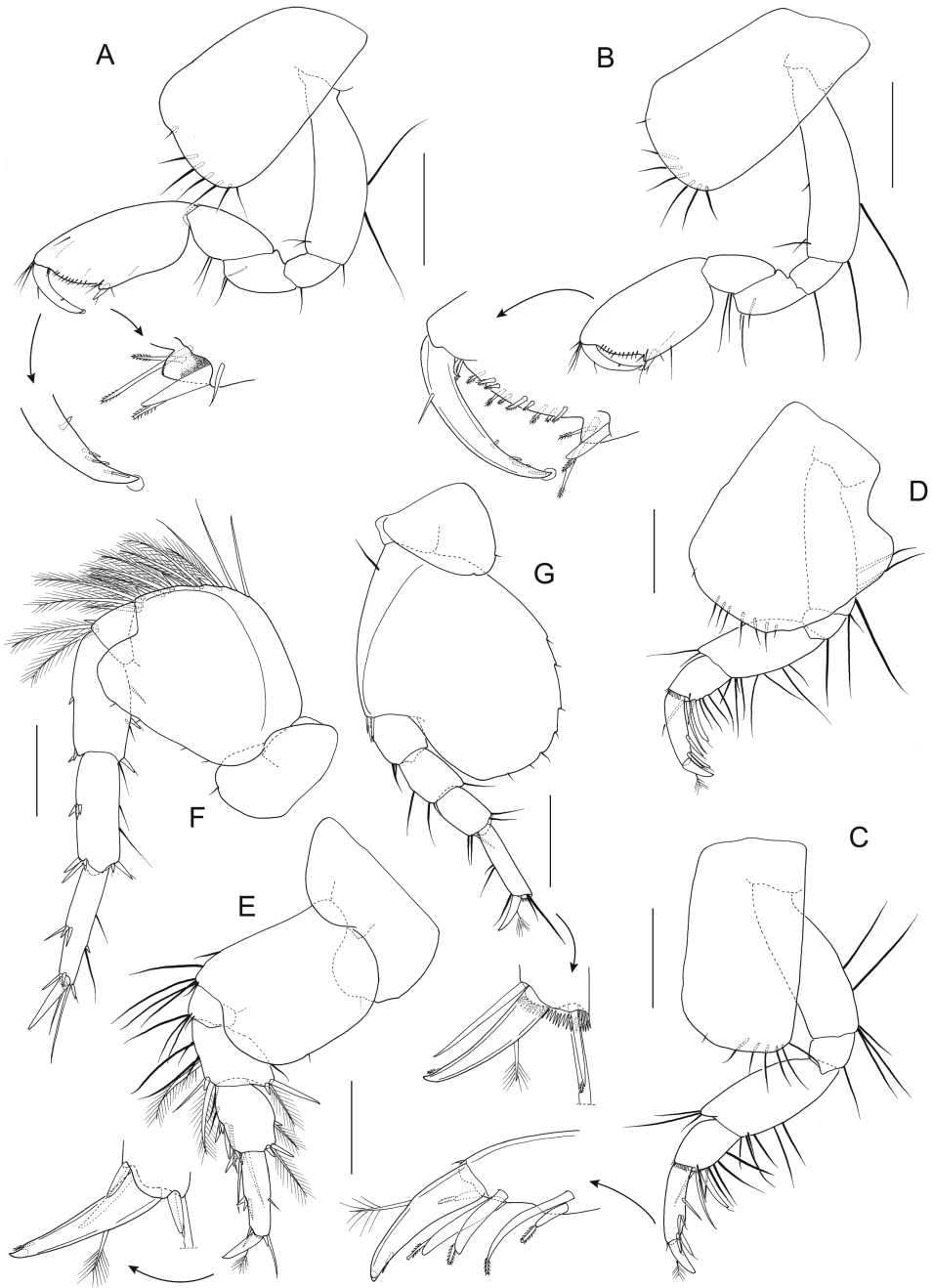


Fig. 2. *Paraphoxus jejuensis* sp. nov., holotype female. A, Gnathopod 1; B, gnathopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, pereopod 7. Scale bars: A-G = 0.2 mm.

Pereopod 4 (fig. 2D), coxa broad, shield-shaped, excavated posteroproximally, about 1.2 times as long as width; carpus short, longer than broad, posterodistal stout spine reaching beyond two-thirds of propodus, other features same as in pereopod 3.

Pereopod 5 (fig. 2E), coxa 5 bilobate, posterior lobe longer than anterior; basis broad, expanded, posterodistal lobe reaching beyond end of ischium; merus as long as propodus, dactylus slender, about 0.5 times length of propodus.

Pereopod 6 (fig. 2F), coxa bilobate, anterior lobe shallow; basis about 4 times length of ischium, anterior margin expanded at middle part, with bunches of long simple and plumose setae, posterior lobe reaching middle of merus; carpus slightly longer than merus; propodus slender; dactylus more than 0.5 times length of propodus.

Pereopod 7 (fig. 2G), coxa entire; basis prominently expanded backward, posterodistal margin extending beyond middle of carpus, weakly serrate, with setules; ischium as long as merus; carpus as long as merus; propodus about 1.5 times length of merus; dactylus slender, less than 0.5 times length of propodus.

Epimera 1-3 (fig. 3A), weakly produced posterolaterally, posteroventral corner rounded without tooth; epimeron 1 smooth, facial seta absent; epimeron 2 smooth, with one facial plumose seta; epimeron 3 smooth, anteroventral margin produced, posterolateral margin notched, with 2 short setae, facial seta absent.

Uropod 1 (fig. 3B), extending beyond uropod 2; peduncle longer than rami, with single basofacial seta, pectinate distally, with 1 mid-lateral seta and 2 stout dorsodistal spines; rami equal in length, nail present; inner and outer rami with 1 stout medial spine, each.

Uropod 2 (fig. 3C), shorter than uropod 1; peduncle longer than rami, without lateral spines and setae, pectinate distally, with 2 stout dorsodistal spines; rami subequal in length, without medial spines, nail present.

Uropod 3 (fig. 3D), stout; peduncle subequal to inner ramus in length, with 1 dorsodistal spine and 2 ventrodistal setae; outer ramus bi-articulate, proximal article about 1.2 times length of peduncle, provided with 1 mid-dorsal seta, 2 dorsodistal setae, and 1 ventrodistal seta; terminal article about 0.3 times length of proximal article, with 2 apical setae; inner ramus shorter than outer, almost reaching two-thirds of outer ramus, with 1 apical seta.

Telson (fig. 3E), completely cleft, 1.5 times as long as width, very narrowed apically, with 2 dorsomedial pinnate setae; each lobe rather slender, rounded apically, and outer distal notches with 1 pinnate seta and 2 weak spines, respectively.

Male.— Unknown.

Other specimens.— Based on paratype female, 3.34 mm, slightly larger than holotype. Antenna 1, primary flagellum 6-articulate; accessory flagellum 4-articulate.

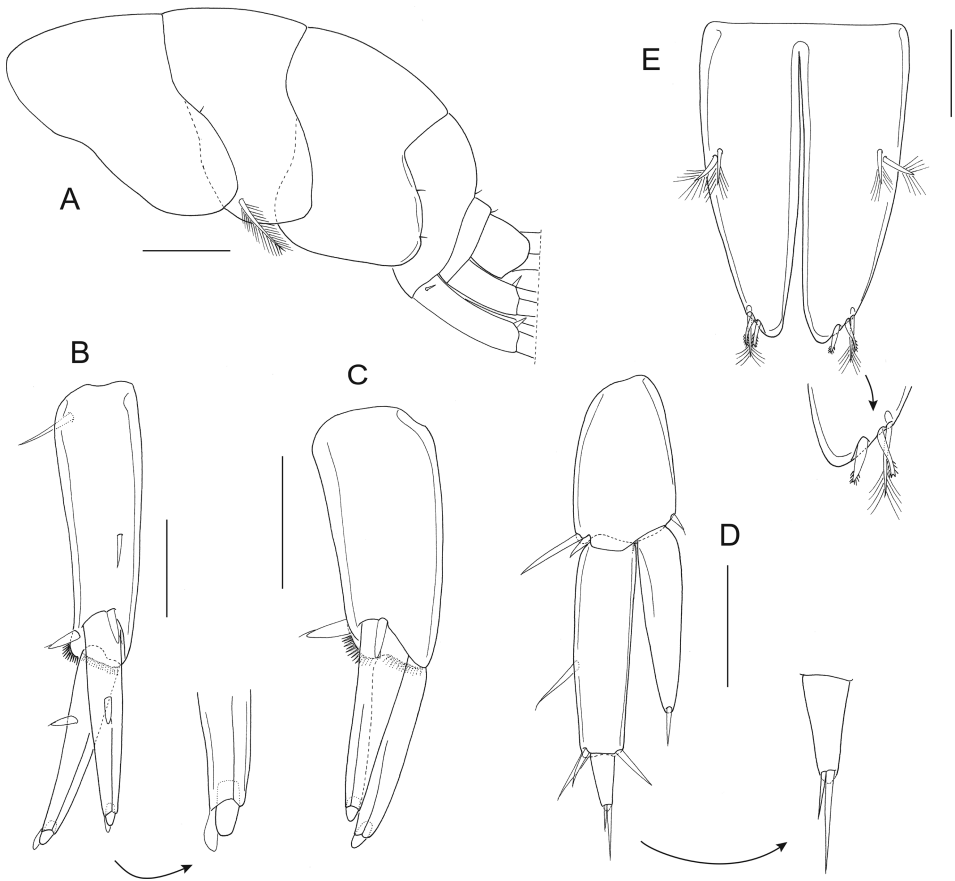


Fig. 3. *Paraphoxus jejuensis* sp. nov., holotype female. A, Pleonites 1-3; B, uropod 1; C, uropod 2; D, uropod 3; E, telson. Scale bars: A = 0.2 mm; B-D = 0.1 mm; E = 0.05 mm.

Uropod 1, peduncle with 2 baso-facial setae. Uropod 2, peduncle with 1 dorsolateral spine and 2 stout dorsodistal spines; rami without medial spines.

Etymology.— Named after the type locality, Jeju Island. The epitheton specificum thus is a geographical adjective, agreeing in gender with the (masculine) generic name.

Remarks.— The new species, *Paraphoxus jejuensis*, is similar to its congeners: *P. communis*, *P. gracilis*, *P. oculatus*, *P. pacificus*, *P. rugosus*, *P. similis*, and *P. tomiokaensis*. All these species share the following characters: (1) the length of the inner ramus of uropod 3 is about half or more than half of the outer ramus; (2) epimeron 3 is produced backwards, without setae on the surface or ventral margin; (3) the posterior lobe on the basis of pereopod 7 reaches the end of the merus. Nevertheless, *Paraphoxus jejuensis* sp. nov. can be distinguished from those seven species by the presence of one or two baso-facial setae on the peduncle of

uropod 1, the presence of a single marginal stout spine on both inner and outer rami of uropod 1, the absence of a marginal spine on both inner and outer rami of uropod 2, the presence of a single ventro-facial plumose seta on epimeron 2; and the presence of a narrowed telson bearing two weak spines and one pinnate seta on the subapical notch of each lobe. Of these seven species, *Paraphoxus tomiokaensis* is very similar to *P. jejuensis*. *Paraphoxus tomiokaensis* was reported from the Ariake Sea of western Kyushu, Japan adjacent to Jeju Island, Korea (Hirayama, 1987). However, the single fossorial spine on the posterodistal corner of the carpi of pereopods 3 and 4 is long, reaching beyond the end of the propodi in *Paraphoxus tomiokaensis*, whereas the spine of *Paraphoxus jejuensis* is shorter than that of *P. tomiokaensis*, reaching a three-fourths portion on the propodi of pereopods 3 and 4. The mandibular molar has 4 stout spines and the outer plate of maxilla 1 has 11 (5 bifid and 6 non-bifid) teeth in *Paraphoxus tomiokaensis*, whereas the mandibular molar has 3 stout spines and the outer plate of maxilla 1 has 9 (3 bifid and 6 non-bifid) teeth in *P. jejuensis*.

Further, *Paraphoxus simplex* was reported by Gurjanova in 1938 from the Sea of Japan. According to the original description of Gurjanova, *Paraphoxus simplex* has the mandibular molar bearing 3 spines, the narrowed telson having sub-apical spines, and the posterior lobe of the basis reaching the end of the merus on pereopod 7. *Paraphoxus simplex*, however, is differentiated from *P. jejuensis* by features of the rostrum, maxilla 1, uropod 3, and pereopod 5. The rostrum of *Paraphoxus simplex* reaches the end of peduncular article 3 of antenna 1, whereas that of *P. jejuensis* reaches the end of peduncular article 1 of antenna 1. On the outer plate of maxilla 1, *Paraphoxus simplex* has 7 teeth, whereas that of *P. jejuensis* has 9 teeth. The outer ramus of uropod 3 in *Paraphoxus simplex* is 3 times the inner ramus in length, whereas that of *P. jejuensis* is about 1.5 times as long as the inner ramus in length. The margins of gnathopods, pereopods and coxae of *Paraphoxus simplex* have many more setae than those of *P. jejuensis*. Finally, the basis of pereopod 5 in *Paraphoxus simplex* is narrow and sub-rectangular in shape, whereas that of *P. jejuensis* is expanded, broad, and sub-ovate in shape.

ACKNOWLEDGEMENTS

I am thankful to anonymous reviewers for valuable comments on this manuscript. This study was supported by the National Marine Biodiversity Institute Research Program (2022M00100).

REFERENCES

- BARNARD, J. L. & M. M. DRUMMOND, 1978. Gammaridean Amphipoda of Australia, Part III: the Phoxocephalidae. *Smithson. Contrib. Zool.*, **245**: 1-551.

- BARNARD, J. L. & G. S. KARAMAN, 1991. The families and genera of marine gammaridean Amphipoda (except marine gammaroids). Parts 1 and 2. Rec. Aust. Mus., Suppl., **13**: 1-866.
- BARNARD, K. H., 1930. Crustacea. Part XI. Amphipoda. British Antarctic ("Terra Nova") Expedition, 1910. Nat. Hist. Rep., Zool., **8**: 307-454, 63 figs.
- GURJANOVA, E. F., 1938. Amphipoda Gammaroidea of Siauku Bay and Sudzukhe Bay (Japan Sea). Reports of the Japan Sea Hydrobiological Expedition of Zoological Institute of the Academy of Sciences USSR in 1934, **1**: 241-404, figs. 1-59.
- HIRAYAMA, A., 1987. Taxonomic studies on the shallow water gammaridean Amphipoda of West Kyushu, Japan VII. Melitidae (*Melita*), Melphidippidae, Oedicerotidae, Philantidae and Phoxocephalidae. Publs Seto Mar. Biol. Lab., **32**: 1-62.
- HORTON, T., J. LOWRY, C. DE BROYER, D. BELLAN-SANTINI, C. O. COLEMAN, L. CORBARI, M. J. COSTELLO, M. DANELIYA, J.-C. DAUVIN, C. FIŠER, R. GASCA, M. GRABOWSKI, J. M. GUERRA-GARCÍA, E. HENDRYCKS, L. HUGHES, D. JAUME, K. JAZDZEWSKI, Y.-H. KIM, R. KING, T. KRAPP-SCHICKEL, S. LECROY, A.-N. LÖRZ, T. MAMOS, A. R. SENNA, C. SEREJO, B. SKET, J. F. SOUZA-FILHO, A. H. TANDBERG, J. D. THOMAS, M. THURSTON, W. VADER, R. VÄINÖLÄ, R. VONK, K. WHITE & W. ZEIDLER, 2022. World Amphipoda Database. Phoxocephalidae G.O. Sars, 1891. World Register of Marine Species, available online at <https://www.marinespecies.org/aphia.php?p=taxdetails&id=101403>.
- JARRETT, N. E. & E. L. BOUSFIELD, 1994. The amphipod superfamily Phoxocephaloidea on the Pacific coast of North America. Family Phoxocephalidae. Part II. Subfamilies Pontharpiinae, Parharpiinae, Brolginae, Phoxocephalinae, and Harpiniinae. Systematics and distributional ecology. Amphipacifica, **1**: 71-150.
- KARAMAN, G., 1988. The genus *Paraphoxus* Sars, 1891. (Contribution to the knowledge of the Amphipoda 171). The Montenegrin Academy of Sciences and Arts, Glasnik of the Section of Natural Sciences, **6**: 139-161.
- REN, X. & L. HUANG, 1991. Studies on Gammaridea and Caprellidea (Crustacea: Amphipoda) from the northwest waters off the Antarctic Peninsula. Studia Marina Sinica, **32**: 185-323.
- SARS, G. O., 1879. Crustacea et Pycnogonida nova in itinere 2^{do} et 3^{tio} expeditionis Norvegicae anno 1877 & 78 collecta. (Prodromus descriptionis). Arch. Math. Naturvid., **4**: 427-476.
- SARS, G. O., 1890-1895. Amphipoda. An account of the Crustacea of Norway with short descriptions and figures of all the species, **1**: 1-711, pls. 1-248. (Christiania [= Oslo] and Copenhagen).
- SENNA, A. R., 2010. A new genus and five new species of Phoxocephalidae (Crustacea: Amphipoda) from the south-east Brazilian deep sea. J. Nat. Hist., **44**: 2075-2118.
- SHIN, M. H., B. A. R. AZMAN & W. KIM, 2015. A new species of the genus *Phoxocephalus* from Pulau Tioman, Malaysia (Crustacea: Amphipoda: Phoxocephalidae). Raffles Bull. Zool., **63**: 529-535.

First received 6 December 2022.

Final version accepted 22 December 2022. Published online 31 January 2023.