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Author(s)	Matsumoto, Yu; Kajihara, Hiroshi; Kakui, Keichi
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A new species of *Leipsuropus* Stebbing, 1899 (Amphipoda: Podoceridae) from Japan

Yu Matsumoto¹ 

Hiroshi Kajihara² 

Keiichi Kakui² 

¹ Graduate School of Science, Hokkaido University. Sapporo 060-0810, Japan

² Faculty of Science, Hokkaido University. Sapporo 060-0810, Japan

KK E-mail: kakui@eis.hokudai.ac.jp

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ABSTRACT

A new podocerid amphipod, *Leipsuropus seisiae* sp. nov., from 338–340 m depth in the Kumano Sea, Japan, Northwestern Pacific, is described. This is the deepest record of any *Leipsuropus* species. *Leipsuropus seisiae* sp. nov. is distinguished from four other congeneric species in having: i) pereonites 2–5 each with five narrow spiniform projections on tergal plate, ii) one dorsal tubercle on the telson, and iii) one small, proximal, denticulate projection on gnathopod-2 palmar margin. A key to males of the species of *Leipsuropus* is provided.

KEYWORDS

Caprelloidea, deep sea, Malacostraca, new species, Peracarida

INTRODUCTION

The family Podoceridae Leach, 1814 is one of five families of the superfamily Caprelloidea Leach, 1814 (Lowry and Myers, 2017). Among which, Podoceridae closely resembles Dulichiidae Dana, 1849 but differs in having a rectangular head and pereopod 7 attached ventrally (not posteroventrally) to pereonite 7 (cf. Myers and Lowry, 2003). The family currently contains eight genera and 89 species (Horton et al., 2022). From Japanese waters, four podocerid species have been reported, and all of them were collected from localities shallower than 100 m depth (Ariyama, 2012; Tomikawa et al., 2019).

Leipsuropus Stebbing, 1899 is one of eight podocerid genera characterized by i) pereonite 1 shorter than head, ii) segmented urosomites 1–3, and iii) two paired uropods (uropod 2 absent). As with other podocerids, members of this genus are efficient climbers on algae and invertebrates such as sponges,

Editor-in-chief
Christopher Tudge

Associate Editor
Cristiana Serejo

Corresponding Author
Keiichi Kakui
kakui@eis.hokudai.ac.jp

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holothuroids, asteroids, and ascidians (Haswell, 1879; Ariyama, 2012; Hughes, 2012). So far, four species have been reported: *Leipsuropus astericolus* Ariyama, 2012 from 98 m depth in the Sea of Japan; *Leipsuropus hongii* Ariyama, 2012 from 108 m depth in the East China Sea; *Leipsuropus parasiticus* (Haswell, 1879) from ca. 5.5 m to 24 m depth along the southeastern coast of Australia; and *Leipsuropus sinensis* Ren, 2012 from 21–87 m depth in the Yellow Sea (Liaodong Bay) and the East China Sea (Ariyama, 2012).

In this paper, we describe a new *Leipsuropus* species based on a single male individual collected from 338–340 m depth in the Kumano Sea, Japan, Northwestern Pacific. This extends the vertical limit of the known distribution of this genus from 108 m to 338 m. In addition, we present a key to males of the currently known species of *Leipsuropus*.

MATERIAL AND METHODS

The single individual was obtained in the Kumano Sea (Fig. 1) with a biological dredge on 7 November 2017 during a research cruise of TR/V “Seisui-maru” (Mie University, Japan). Collected bottom sediment was sieved by a 0.45-mm mesh; the podocерid was picked from the residue and then fixed and preserved in 70% ethanol. The methods used for dissection,

preparation of slides, light microscopy, and drawing were as described by Kakui and Angsupanich (2012). The studied specimen was deposited in the Invertebrate Collection of the Hokkaido University Museum (ICHUM), Sapporo, Japan.

Morphological terminology follows LeCroy (2000) and Ariyama (2012). Body length was measured from the base of the antenna 1 along the lateral margin to the posterior end of the urosomite 3. Pereopod lengths were measured from the proximal end of basis along the lateral margin to the distal end of dactylus. Pleopod lengths were measured from the proximal end of peduncle to the distal end of the inner ramus. All measurements were done with ImageJ (<https://imagej.nih.gov/ij/>).

SYSTEMATICS

Family Podoceridae Leach, 1814

Genus *Leipsuropus* Stebbing, 1899

Leipsuropus seisuiiae sp. nov.

(Figs. 2–6)

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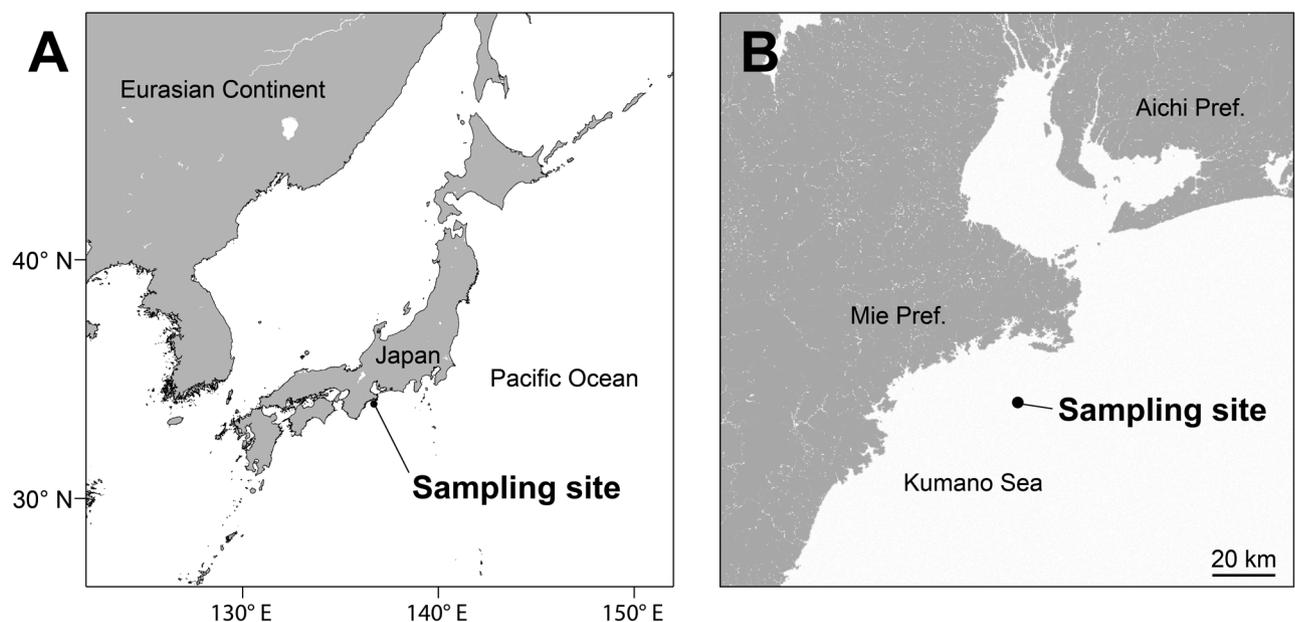


Figure 1. Map showing the sampling site. **A, B**, map showing the sampling site in Japan and the Kumano Sea. Maps were generated by using GMT6 (A, Wessel et al., 2019) or based on GSI Maps (B, <https://maps.gsi.go.jp>).



Figure 2. Photograph of lateral view of *Leipsuropus seisiae* sp. nov., male, holotype, ethanol fixed specimen. Scale bar: 1 mm.

Type material. Holotype: male, 3.4 mm, ICHUM6353; TR/V “Seisui-maru”, Stn. 1, Kumano Sea, Northwestern Pacific (34°06.92’N 136°42.73’E to 34°04.98’N 136°42.25’E), 340–338 m depth, biological dredge, 7 November 2017, Y. Matsumoto and K. Kakui coll.

Diagnosis (male). Pereonites 2–5 each with five narrow spiniform projections on tergal plate. Pereonites 6 and 7 segmented. Telson with dorsal tubercle. Gnathopod-2 palm with small, proximal, denticulate projection.

Description of holotype. Body (Figs. 2, 3A–C, 6D) 3.4 mm long, depressed. Head with mid-dorsal spiniform projection, pair of dorsolateral spiniform projections, and pair of ventral projections at insertion of antenna 2. Pereonite 1 with 2 mid-dorsal spiniform projections and pair of lateral spiniform projections. Pereonites 2–7 segmented, each with mid-dorsal spiniform projection, pair of dorsolateral spiniform projections, and pair of lateral spiniform projections. Pleonites 1–2 each with mid-dorsal spiniform projection and pair of dorsolateral projections. Pleonite 3 without projection. Urosomites 1–3 without projection; urosomite 1 with posterodorsal simple seta. Telson (Figs. 3B, 6D) linguiform, with dorsal tubercle bearing dorsal simple seta.

Antenna 1 (Fig. 4A) with peduncular article 1 having ventral setulose setae and dorsal bifurcate setae; other parts lost. Antenna 2 (Fig. 4B) with peduncular articles 1–2 (fused) having distolateral projection and antennal gland cone directed ventrodistally; peduncular article 3 with ventral setulose setae and dorsal bifurcate setae; other parts lost.

Upper lip (Fig. 4C; partly broken) ventrally setulated, with ventral hollow. Epistome (Fig. 4D) produced anteriorly. Mandibles (Fig. 4E, E1, F, F1) with incisor bearing 5 cusps; lacinia mobilis with 3 cusps; subdistal region with 3 (left) or 2 (right) accessory blades and 3 (left) or 1 (right) plumose seta; molar with plate-like structure bearing pectinate margin. Palp with naked article 1; article 2 with medial setulose setae; article 3 distally expanded, with setulose setae in distal half. Lower lip (Fig. 4G) with developed inner lobes and mandibular processes; distal region of inner and outer lobes covered with thin setae. Maxilla 1 (Fig. 4H) with vestigial inner plate; outer plate with 8 distal robust setae (6 bifurcate, 2 simple). Palp with naked article 1; article 2 with 7 distal robust setae (1 broken, 3 serrate, 3 simple), ventral simple seta, and 3 dorsal setulose setae. Maxilla 2 (Fig. 4I) with inner and outer plates having distal setulose setae and covered with thin setae. Maxillipeds (Fig. 4J, J1) with inner plate bearing 6 distal setulose setae and 3 distal short robust setae; outer plate with 4 distal setulose setae and 5 medial robust setae and several medial simple setae. Palp with 4 articles; article 1 naked; article 2 with distal and medial setulose setae; articles 3–4 with setulose setae on almost all surfaces.

Gnathopod 1 (Figs. 3A, 5A, A1) subchelate. Coxa with slight lateral projection. Basis with 1 anterior and 1 posterodistal simple setae. Ischium with posterodistal setulose setae. Merus with posterior setulose setae. Carpus with 1 medial and several posterior setulose setae. Propodus with setulose setae on almost all margins; palmar margin slightly concave, with proximomedial 4 robust setulose setae. Dactylus slightly curved posteriorly, with 2 postero-subdistal denticles.

Gnathopod 2 (Figs. 3C, 5B, B1) subchelate. Coxa with lateral projection. Basis with 1 mid-posterior and 3 posterodistal simple setae and lateral anterodistal spiniform projection. Ischium with 2 posterodistal simple setae. Merus with 5 posterodistal simple setae and posterodistal spiniform projection. Carpus short, with simple setae on antero- and posterodistal corners. Propodus ovate, with simple setae on almost all margins; palmar margin with proximal small denticulate projection, proximal bifurcate robust seta, mid-plumose seta, and 11 robust setae. Dactylus curved posteriorly.

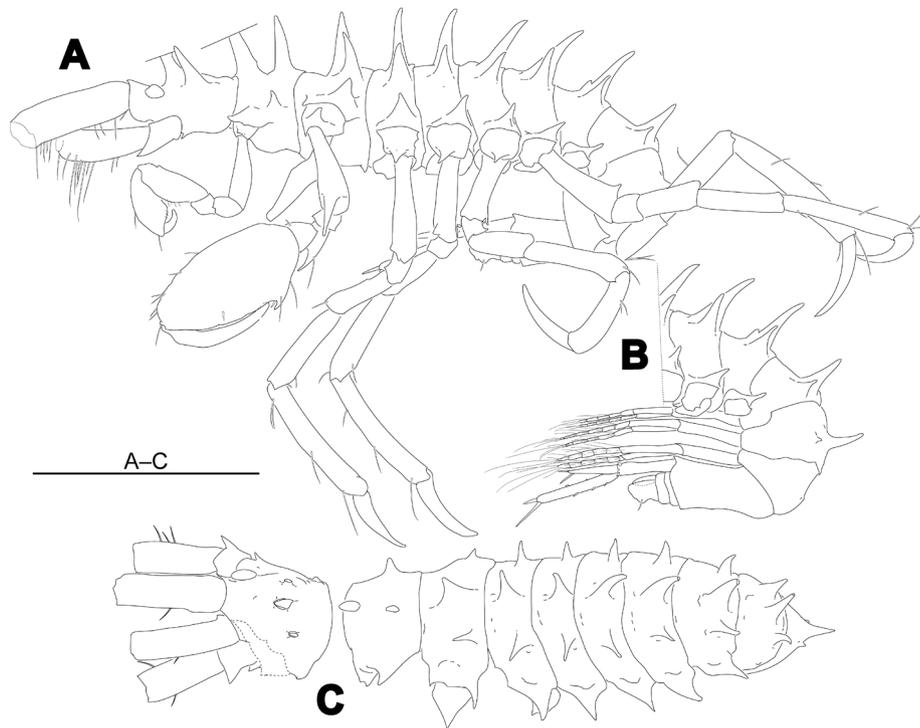


Figure 3. *Leipsuropus seisiae* sp. nov., male, holotype. **A**, Body, lateral view, pleopods omitted; **B**, posterior portion of body, lateral view, body, pereopods omitted; **C**, head, pereon, and pleonites 1–2, dorsal view. Scale bar: 1 mm.

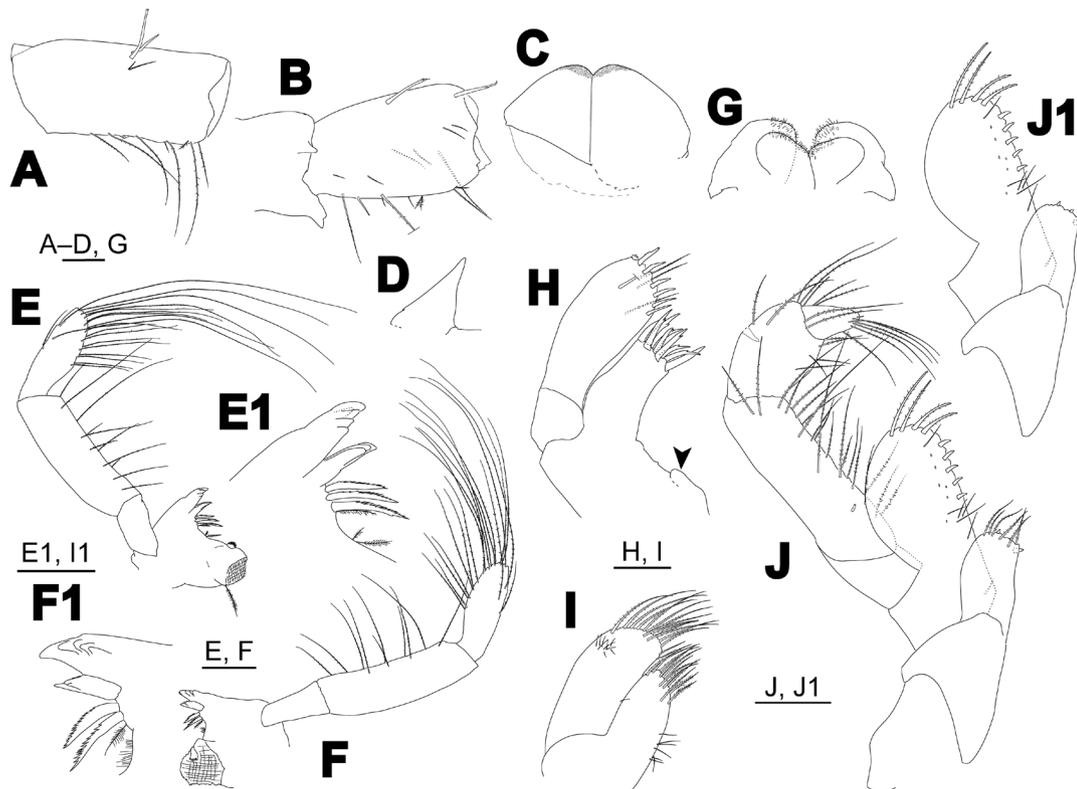


Figure 4. *Leipsuropus seisiae* sp. nov., male, holotype. **A**, Peduncular article 1 of right antenna 1, lateral view; **B**, peduncular articles 1–3 (articles 1, 2 fused) of right antenna 2, lateral view; **C**, upper lip, anterior view; **D**, epistome, lateral view; **E**, **F**, left and right mandibles, medial views; **E1**, **F1**, distal portion of left and right mandibles, medial views; **G**, lower lip, ventral view; **H**, right maxilla 1, ventral view (arrowhead, inner plate); **I**, left maxilla 2, dorsal view; **J**, left maxilliped, dorsal view; **J1**, outer and inner plates of right maxilliped (some setae of inner plate omitted). Scale bars: A, B, E–G, 0.1 mm; C, D, H–J, E1, F1, J1, 0.05 mm.

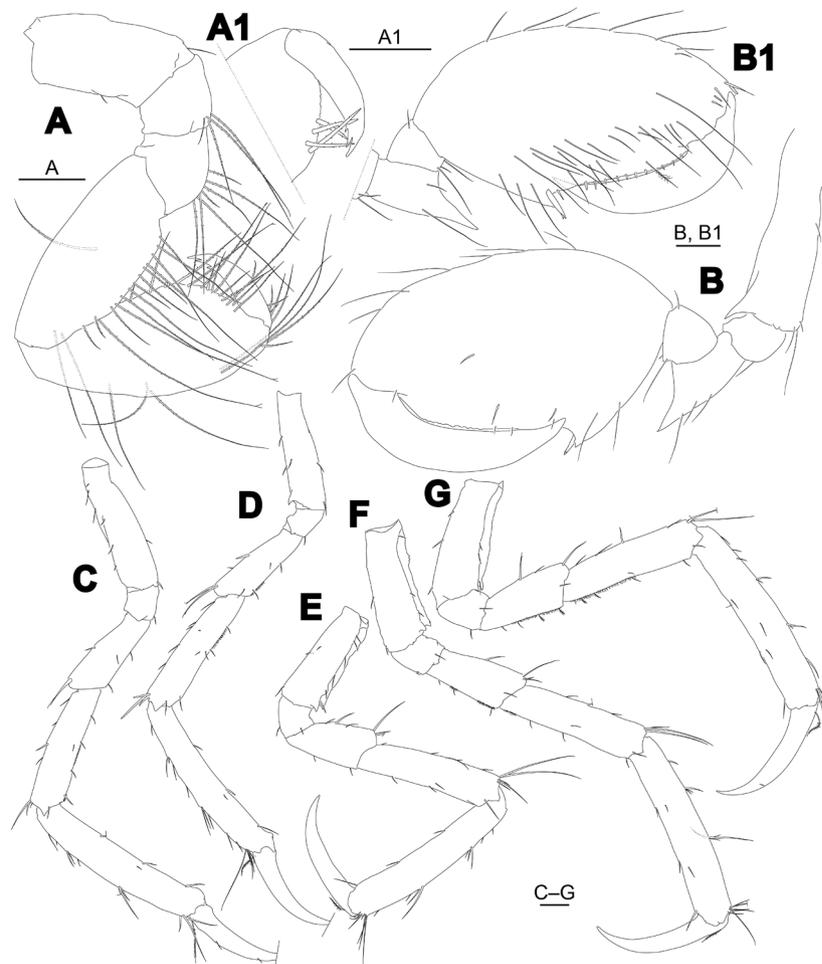


Figure 5. *Leipsuropus seisuiiae* sp. nov., male, holotype. **A**, Left gnathopod 1, lateral view (robust setulose setae on palm omitted); **A1**, palm and dactylus of left gnathopod 1, medial view (setulose setae omitted); **B**, left gnathopod 2, lateral view (medial setae omitted); **B1**, distal part of left gnathopod 2, medial view (lateral setae omitted); **C–G**, left pereopods 3–7, lateral view. Scale bars: 0.1 mm.

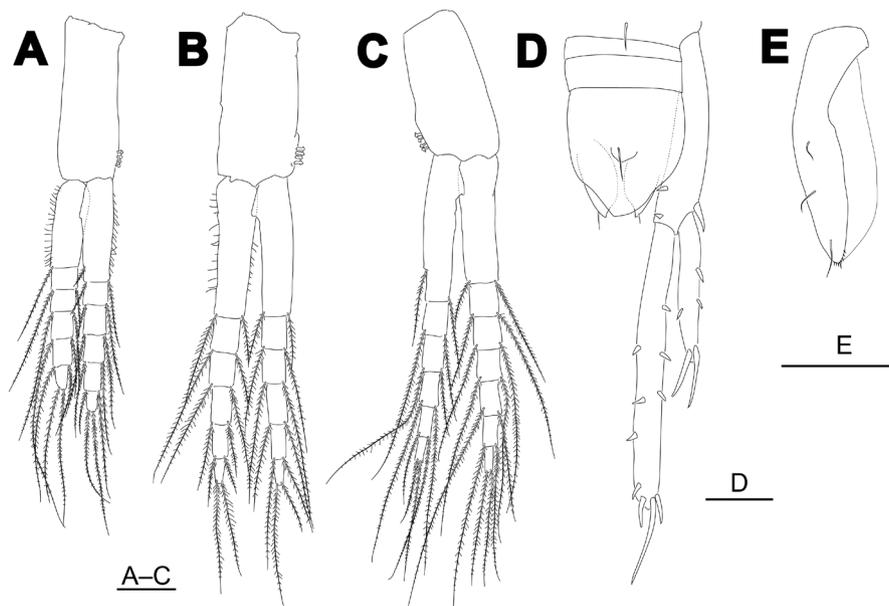


Figure 6. *Leipsuropus seisuiiae* sp. nov., male, holotype. **A–C**, Left (**A**, **B**) or right (**C**) pleopods 1–3, posterior views; **D**, urosome, telson, and uropods 1 and 3, dorsal view; **E**, left uropod 3, lateral view. Scale bars: **A–D**, 0.1 mm; **E**, 0.05 mm.

Pereopod 3 (Figs. 3A, C, 5C) 2.33 mm long, with length ratio of basis, ischium, merus, carpus, and propodus 1.00:0.24:0.64:1.01:1.37 (tip of dactylus broken). Coxa pointed laterally. Basis with anterior and posterior simple setae. Ischium with posterodistal simple seta. Merus with posterior simple setae, mid-anterior thick seta and anterodistal bifurcate thick seta. Carpus with anterior, posterior, and distal simple setae and mid-anterior, anterodistal, and posterodistal thick setae. Propodus with anterior simple setae and anterior, posterior, and distal thick setae. Dactylus slightly curved, with 2 anterior simple setae and mid-anterior plumose seta. Pereopod 4 (Figs. 3A, 5D) 2.32 mm long, with length ratio of articles from basis to propodus 1.00:0.25:0.73:1.16:1.50 (tip of dactylus broken). Similar to pereopod 3 except: basis with lateral anterodistal spiniform projection; dactylus without anterior simple setae. Pereopod 5 (Figs. 3A, 5E) 2.34 mm long, with length ratio of articles from basis to dactylus 1.00:0.27:0.61:1.30:1.65:1.08. Similar to pereopod 4. Pereopod 6 (Figs. 3A, 5F) 2.45 mm long, with length ratio of articles from basis to dactylus 1.00:0.27:0.68:1.23:1.63:1.05. Similar to pereopod 5. Pereopod 7 (Figs. 3A, 5G) 2.57 mm long, with length ratio of articles from basis to dactylus 1.00:0.28:0.68:1.22:1.65:1.13. Similar to pereopod 6.

Pleopods 1–3 (Fig. 6A–C) 0.66 mm, 0.80 mm, 0.76 mm long, respectively. Peduncle with 4 mediobasal coupling hooks. Each segment of both rami bearing 1–3 plumose setae.

Uropod 1 (Fig. 6D) biramous. Peduncle with 1 distolateral and 2 mediobasal robust setae. Inner

ramus with 3 lateral, 3 medial and 4 distal robust setae. Outer ramus with 2 lateral, 1 medial, and 2 distal robust setae. Uropod 3 (Fig. 6D, E) curled, with distal thin setae and 3 dorsal simple setae.

Etymology. The specific name is a noun in the genitive case and derived from TR/V “Seisui-maru”, the vessel from which the type specimen was collected.

Type locality. Kumano Sea, Japan, Northwestern Pacific (34°06.92'N 136°42.73'E to 34°04.98'N 136°42.25'E), 340–338 m depth.

Distribution. So far known only from the type locality.

Remarks. *Leipsuropus seisuiiae* sp. nov. is the fifth named species in *Leipsuropus*. Pereonites 2–7 of male *L. seisuiiae* sp. nov. each has five projections on the tergal plate: one dorsal, a pair of dorsolateral, and a pair of lateral projections. This condition was also found in male *L. hongii*, but *L. seisuiiae* sp. nov. is distinguished from *L. hongii* by: i) dorsal projection on the pereonites is narrow and spiniform (broad, keel-like in *L. hongii*), ii) gnathopod-2 palmar margin has one small, proximal, denticulate projection (one wide and two large triangular projections in *L. hongii*), and iii) the telson has a dorsal tubercle (no tubercle in *L. hongii*) (Ariyama, 2012). Differences among congeners including *L. seisuiiae* sp. nov. in a combination of five character states are presented in Tab. 1. A key to world *Leipsuropus* males is given below.

Key to males of the species of *Leipsuropus*

1. Dorsal projections on body absent *L. parasiticus* (Haswell, 1879)
- 1'. Dorsal projections on body present 2
2. Tergal plate of pereonites 2–5 with 1 projection *L. sinensis* Ren, 2012
- 2'. Tergal plate of pereonites 2–5 with 3 or 5 projections 3
3. Tergal plate of pereonites 2–5 with 3 projections *L. astericolus* Ariyama, 2012
- 3'. Tergal plate of pereonites 2–5 with 5 projections 4
4. Dorsal projections on body broad and keel-like; gnathopod-2 palmar margin with one wide and two large triangular projections *L. hongii* Ariyama, 2012
- 4'. Dorsal projections on body narrow and spiniform; gnathopod-2 palmar margin with small, proximal, denticulate projection *L. seisuiiae* sp. nov.

Table 1. Comparison of selected characters between males in *Leipsuropus*.

Characters	<i>L. seisuia</i> sp. nov.	<i>L. astericolus</i>	<i>L. hongii</i>	<i>L. parasiticus</i>	<i>L. sinensis</i>
No. of projections on tergal plate of pereonites 2–5	5 each	3 each	5 each	Absent	1 each
Shape of dorsal projection	Narrow spiniform	Broad keel-like	Broad keel-like	–	Broad keel-like
Pereonites 6 and 7	Segmented	Segmented	Segmented	Fused	Segmented
Dorsal tubercle on telson	Present	Absent	Absent	Absent	Present
Projections on palm of gnathopod 2	1 small, proximal, denticulate	1 wide and 2 large triangular	1 wide and 2 large triangular	1 large triangular and 1 digitiform	Absent
Source	This study	Ariyama (2012)	Ariyama (2012)	Barnard and Drummond (1981)	Ren (2012)

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ADDITIONAL INFORMATION AND DECLARATIONS

Author Contributions

Conceptualization and Design: YM, HK. Performed research: YM. Acquisition of data: YM. Analysis and interpretation of data: YM. Preparation of figures/tables/maps: YM and KK. Writing - original draft: YM, KK, HK. Writing - critical review & editing: KK.

Consent for publication

All authors declare that they have reviewed the content of the manuscript and gave their consent to submit the document.

Competing interests

The authors declare no competing interest.

Data availability

All study data are included in the article

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Study association

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