



A new species of *Liropus* (Crustacea, Amphipoda, Caprellidae) from California, USA, with an illustrated key of the genus

JOSE M. GUERRA-GARCÍA^{1,3} & ED A. HENDRYCKS²

¹Laboratorio de Biología Marina, Departamento de Zoología, Facultad de Biología, Universidad de Sevilla, Avda Reina Mercedes 6, 41012, Sevilla, Spain. E-mail: jmguerra@us.es

²Canadian Museum of Nature, Research and Collections, P.O. Box 3443, Station D, Ottawa, Canada, K1P 6P4

³Corresponding author

Abstract

A new species of the genus *Liropus* (Crustacea, Amphipoda, Caprellidae) is described based on specimens collected from a small cave of Santa Catalina Island, California. The new species, *Liropus minusculus*, can be distinguished from all its congeners mainly by the presence of anterolateral projections on pereonites 2, 3, and 4 (males), pereopod 5 one-articulate (although with a second article incompletely tabicated), basis of gnathopod 2 very elongate (males), and abdomen with two pairs of one-articulate appendages (males), one of them rudimentary. Up-to-date morphological comparisons among the world *Liropus* species are provided, together with an illustrated key to species. This is the first record of *Liropus* from the north-east Pacific.

Key words: Crustacea, Amphipoda, Caprellidae, *Liropus*, new species, North Pacific, California

Introduction

Since Mayer's monographic works (1882, 1890, 1903) on the caprellid amphipods revealed the diverse nature of the North American Pacific fauna, few studies have been published on the systematics, distribution, or ecology of these animals in this region (Laubitz 1970; McCain & Steinberg 1970). Dougherty & Steinberg (1953) studied the caprellids of California between latitudes 36°N and 38°N and listed 20 species. Jensen (1969) reported habitat and general ecological information on many Pacific coast species. Laubitz (1970) conducted a comprehensive work and provided details and/or figures of 26 species found in the North American Pacific between latitudes 40°N and 60°N, including ecological notes and a zoogeographical discussion. Laubitz (1970) examined the fauna from the Gulf of Alaska to southern Oregon, and Martin (1977) covered the caprellids from the Oregon-California border to Fort Bragg, California. Marelli (1981) pointed out that the composition of the caprellid fauna from the whole central California region had not been recently studied, but provided new records of *Caprella alaskana*, *C. mutica* and *C. scaura*. Watling & Carlton (2007) provided a detailed revision, including an illustrated guide and a list of 31 species of caprellids from California. This list does not include the species *Aciconula acanthosoma*, described by Chess (1989) based on material collected from Isthmus Reef, Santa Catalina Island, California.

During a short visit to the Canadian Museum of Nature (October 2010), abundant caprellid material collected from the Pacific coast of the USA housed at the Museum was identified by the first author. A vial containing two tiny and interesting specimens (male and female) collected by J.R. Chess from a small cave of Isthmus Reef, Santa Catalina Island, was found. A detailed examination of the material revealed that the specimens belong to an undescribed species of the genus *Liropus*, representing the first record of the genus for the north-east Pacific coast.

Material and methods

For morphological comparison with other species of the genus *Liropus*, material from the Muséum National

d'Histoire Naturelle (MNHN), Paris, the United States National Museum (USNM), Washington, DC and the Museo Nacional de Ciencias Naturales (MNCN), Madrid, was examined. All dissected appendages were mounted in polyvinyl-lactophenol. The figures were drawn using a Leica compound microscope equipped with a camera lucida. Body length was measured from the anterior end of the head to the posterior end of pereonite 7. The symbols used in the present work are: A1, 2 = Antenna 1, 2; LL = Lower lip; LMd = Left mandible; RMd = Right mandible; Mx 1, 2 = Maxilla 1, 2; Mxp = Maxilliped; Gn 1, 2 = Gnathopod 1, 2; P5–7 = Pereopod 5–7; Ab = Abdomen; Pe = Penes. In the descriptions, the term “spine” is used for stout, inflexible articulated structures, “seta” for slender, flexible articulated structures and “setule” for very short setae. Specimens of the new species are deposited in the collections of the Canadian Museum of Nature (CMN), Ottawa, Canada.

Systematics

Superfamily Caprelloidea Leach, 1814

Family Caprellidae Leach, 1814

Subfamily Caprellinae Leach, 1814

Genus *Liropus* Mayer, 1890

(see classification of Lowry and Myers, 2013)

Liropus minusculus n. sp.

Diagnosis. Eyes present. Body dorsally smooth. Anterolateral projections on pereonites 2, 3 and 4 in males and absent in females. Flagellum of antenna 1 more than two-articulate. Basis of gnathopod 2 longer than pereonite 2. Pereopods 3 and 4 one-articulate. Pereopods 5 one-articulate (although with a second article incompletely tabicated). Abdomen with two pairs of one-articulate appendages in males, one of them rudimentary

Type material. Holotype: male, 3.3 mm (body and 2 slides) (CMNC 2013-0001) and paratype female, 2.1 mm (body) (CMNC 2010-6721), collected from a small cave at Isthmus Reef, 9,1 m depth, Santa Catalina Island, California, USA, approximately 33°26'50"N, 118°29'25"W.

Etymology. The specific name *minusculus* refers to the small size of the specimens, which is the smallest species of *Liropus*.

Distribution. Only known from the type locality.

Description. **Holotype**, male (3.3 mm).

Lateral view (Fig. 1). Body dorsally smooth. Head rounded, lacking any projections, eyes present. Pereonite 1 fused with head, suture present. Pereonites 2, 3 and 4 provided with a pair of anterolateral projections. Pereonites 3 and 4 with a developed pleura laterally. Pereonite 5 the longest. Pereonite 7 the shortest. Pereonites 6 and 7 slightly tabicated.

Gills (Fig. 1). Present on pereonites 3-4, oval, length about 1.5 times width. Gills on pereonite 3 larger than those on pereonite 4.

Mouthparts (Fig. 2). Mandibles with tritritive molar and three-articulate palp; distal article of palp the longest, with one setae apically; left mandible with incisor and lacinia mobilis five-dentate, accessory spine row with two spines; incisor of right mandible five-dentate, lacinia mobilis looking like a spine, followed by two more spines; molar flake present in the right mandible as a broad blade. Lower lip without setae; inner lobes almost fused. Maxilla 1 outer lobe carrying seven spines, palp two-articulate, distal article with four apical spines and one medial setae. Maxilla 2 inner lobe trapezoidal, shorter than outer lobe, carrying five distal setae; outer lobe rectangular, with seven apical setae. Maxilliped inner plate rectangular carrying two setae and a two nodular setae; outer plate oval, with three setae; palp four-articulate, second article the longest, third article provided with a distal projection and dactylus with two setae and tiny setulae distally.

Antennae (Figs. 1 and 3). Antenna 1 about one third of body length; peduncular articles 1-3 in ratio of 1: 1.5: 0.6, proximal article of peduncle without projection; flagellum 5-articulate. Antenna 2 about two-thirds of antenna

1; peduncular articles 3–4 in ratio of 1: 1.5, proximal peduncular article with a well developed acute gland cone distally; swimming setae absent; flagellum two-articulate.

Gnathopods (Figs. 1 and 3). Gnathopod 1 basis longer than the combination of ischium, merus and carpus; margin of propodus relatively straight, palm finely serrated; proximal grasping spine present, dactylus bifid distally. Gnathopod 2 inserted on the anterior half of pereonite 2; basis twice as long as pereonite 2 in length; ischium rectangular; merus rounded; carpus short and triangular; propodus elongated, as long as basis, anterior margin strongly convex; palm long and concave, setose, with proximal projection provided with one grasping spine, followed by a strong toothlike projection; dactylus with setulae and narrowed medially, reaching grasping spine.

Pereopods (Figs. 1 and 4). Pereopod 3 and 4 extremely reduced, one-articulate, with two and three setae distally. Pereopod 5 one-articulate (with a minute article distally, not totally tabicated), with 4 setae distally. Pereopod 6 six-articulate, attached to the posterior end of the pereonite, basis without carina, ischium short and rectangular, propodus and carpus palm carrying a row of spines, dactylus strongly curved. Pereopod 7 larger than pereopod 6, but similar in feature, carpus and propodus proportionately longer, dactylus longer and straighter.

Penes (Fig. 4) situated medially, distinctive, oval, length ca 1.5 times width.

Abdomen (Fig. 4) with two pairs of one-articulate appendages, one of them rudimentary, a pair of lobes, and a single dorsal lobe.

Paratype, female (2.1 mm). Similar to the male except for the following characteristics: head relatively shorter. Antenna 1 flagellum 4-articulate. Presence of oostegites on pereonites 3 and 4, oostegites setose on pereonite 3 (Fig. 1). Pereonite 2, 3 and 4 lacking lateral projections. Gnathopod 2 (Fig. 3) basis much shorter than in male, propodus much smaller and more oval in shape, palm slightly convex with only one weak proximal projection, dactylus straighter, not setose. Abdomen (Fig 4) without any projections.

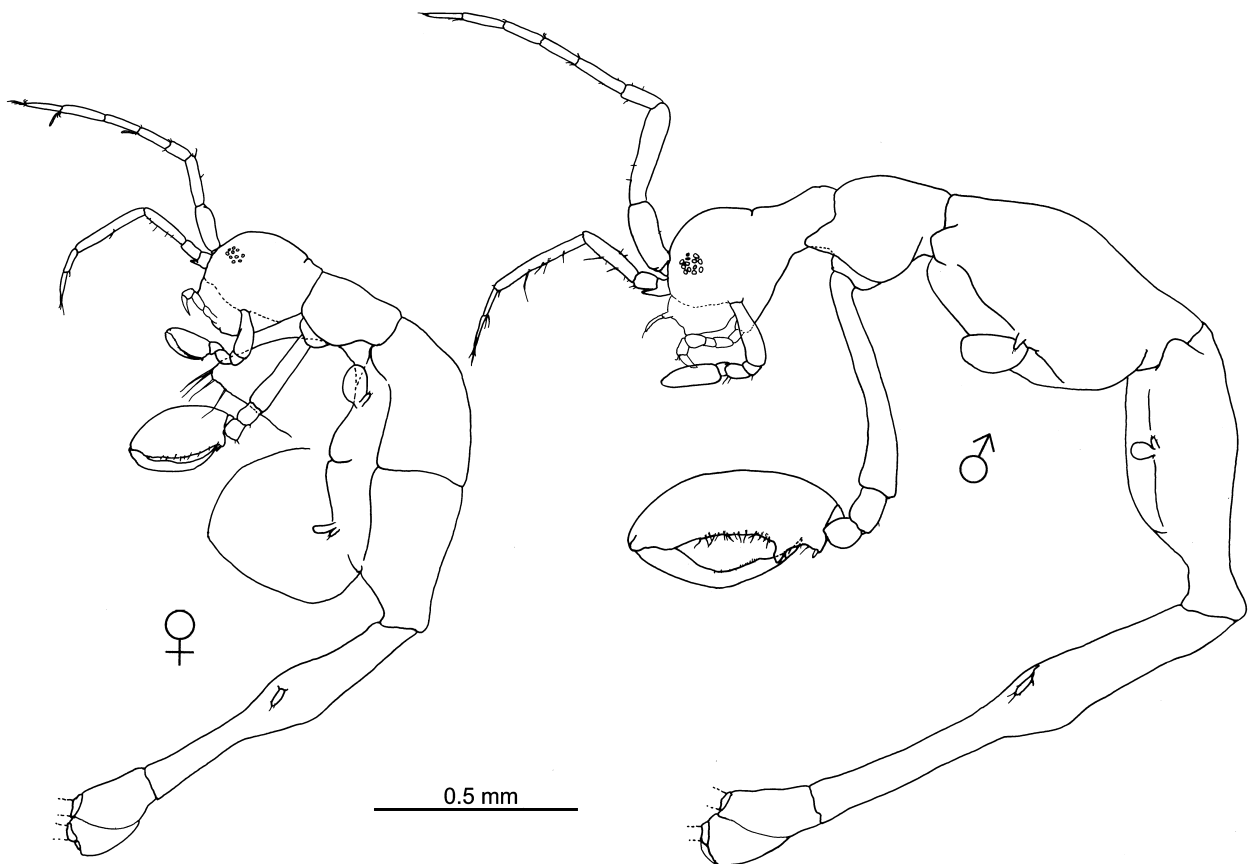


FIGURE 1. *Liropus mimusculus* n. sp. Lateral view, left side, holotype male and paratype female.

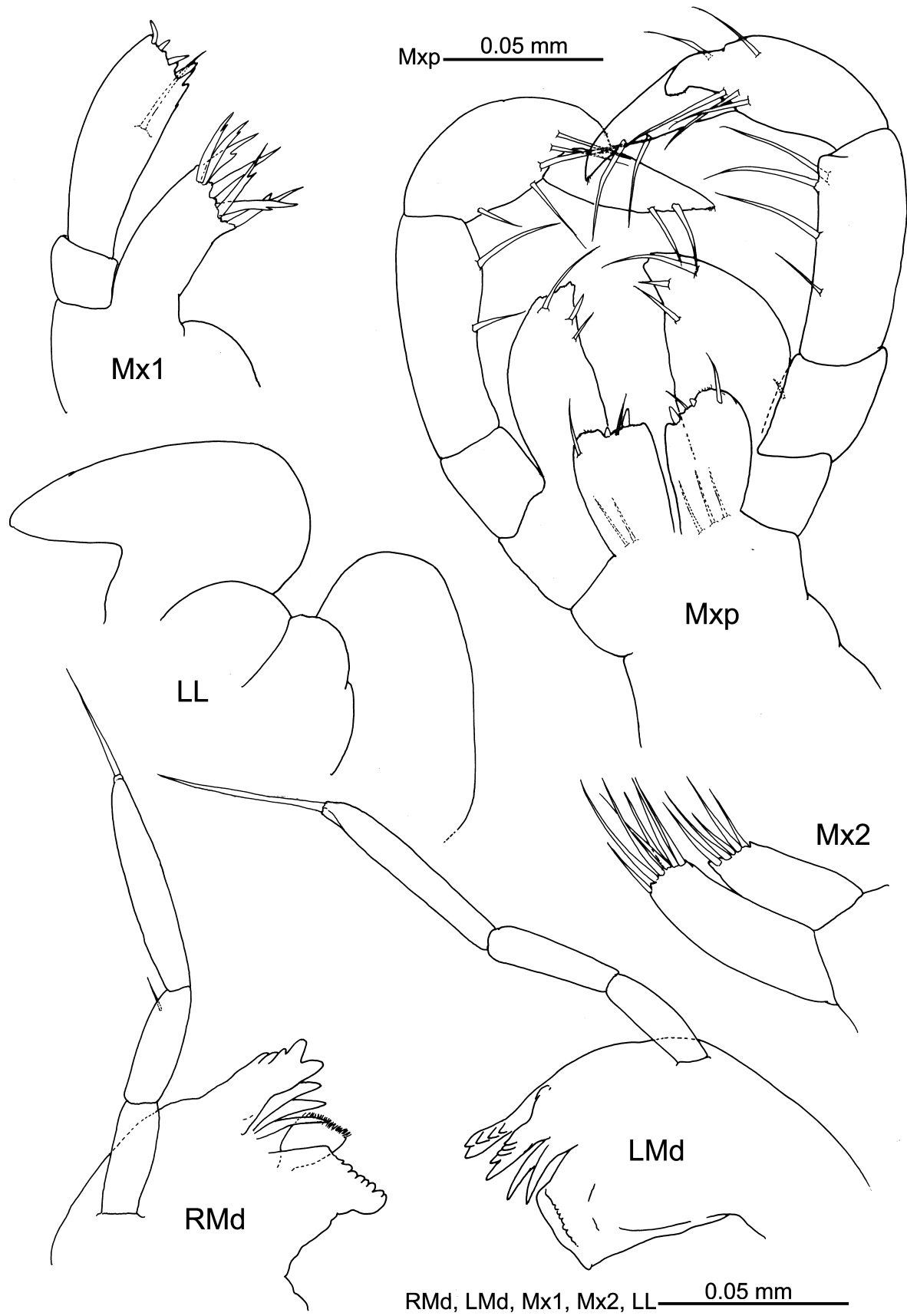


FIGURE 2. *Liropus minusculus* n. sp. Holotype male mouthparts.

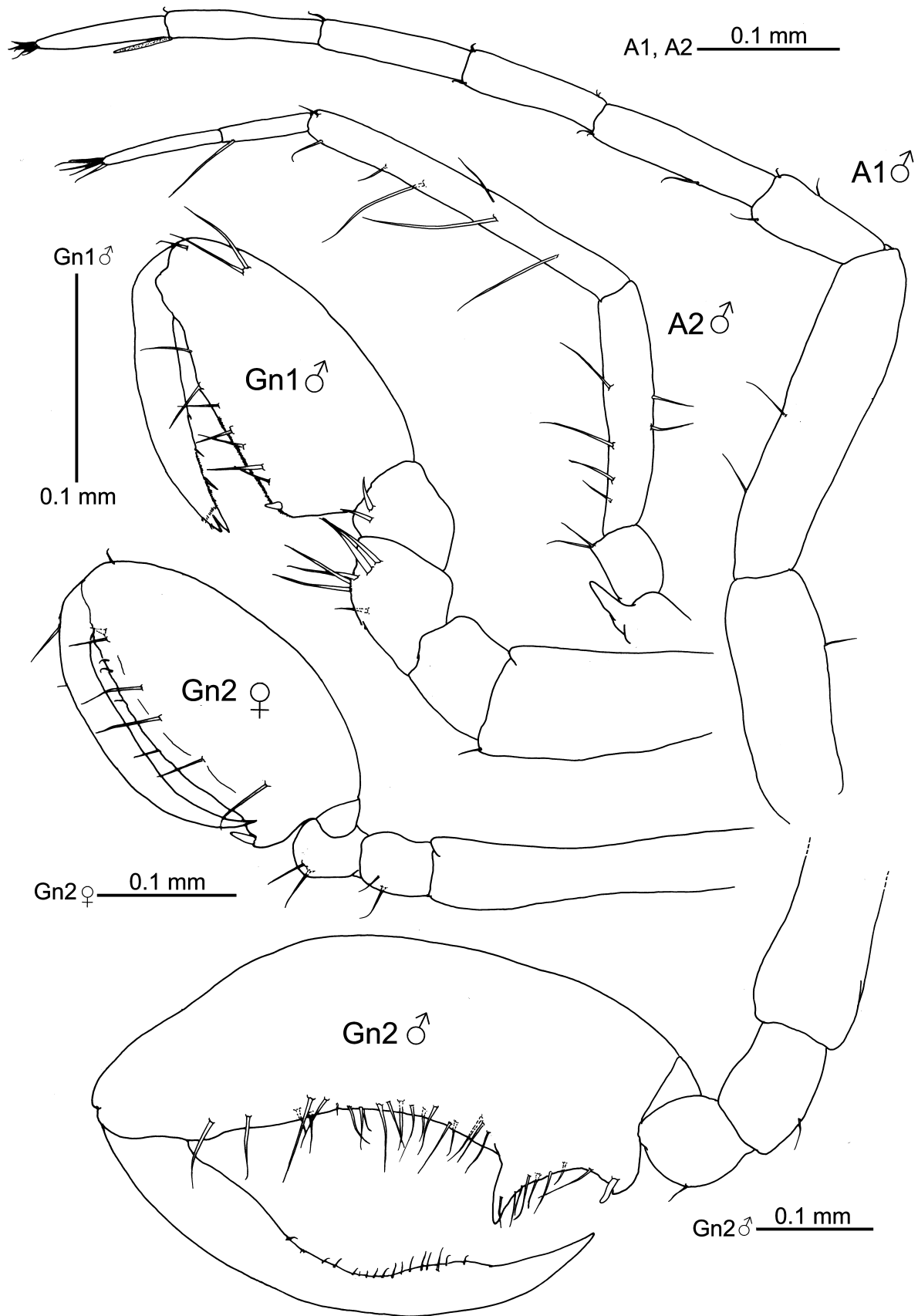


FIGURE 3. *Liropus minusculus* n. sp. Holotype male antennae, gnathopod 1 and 2. Paratype female gnathopod 2.

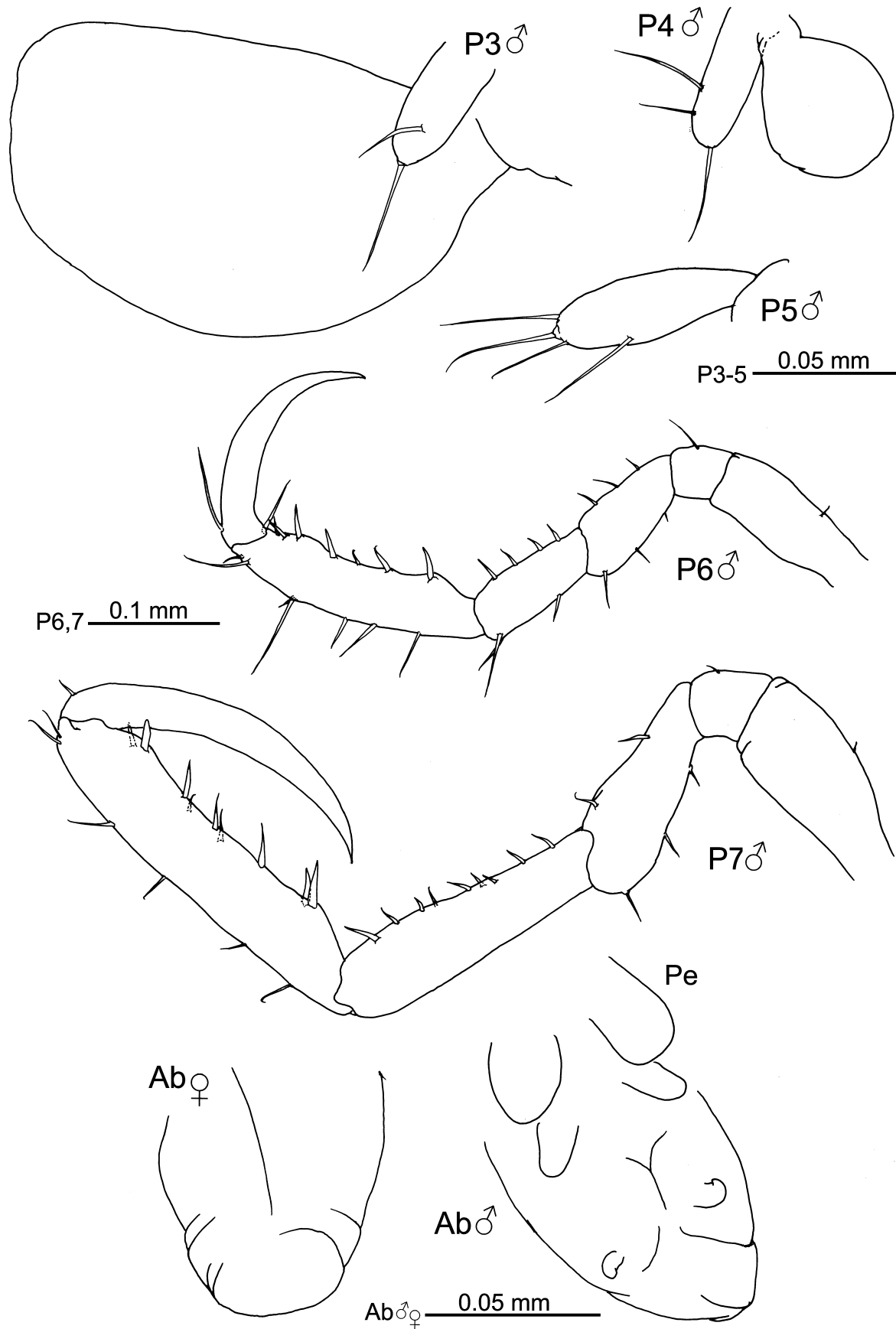


FIGURE 4. *Liropus minusculus* n. sp. Holotype male pereopods 3-7 and abdomen. Paratype female abdomen.

TABLE 1. Comparison of selected characters among *Liropus* species based on data from Mayer (1890, 1903, 1920), Chevreux (1927), Krapp-Schickel (1993), Mori (1995), Guerra-García (2003, 2004) and Guerra-García et al. (2008). Caprellid specimens have been examined for the following species: *L. africanus* (MNHN-Am 5028), *L. azorensis* (MNHN-Am 5259, 5260, 2949, 2956), *L. cachuchoensis* (MNCN 20.04/6072-74, MNHN-Am 5835), *L. elongatus* (MNHN-Am 5082), *L. gracilis* (MNHN-Am 5245) and *L. nelsonae* (USNM 1008383, 1008384, 1008385). Modified from Guerra-García et al. (2008).

	<i>L. africanus</i>	<i>L. azorensis</i>	<i>L. cachuchoensis</i>	<i>L. elongatus</i>	<i>L. gracilis</i>	<i>L. japonicus</i>	<i>L. minimus</i>	<i>L. minusculus</i>	<i>L. nelsonae</i>
Body length (mm)	Male 3.5 Female ?	6.7 5.8	5.3 4.6	5.0 4.5	1.2 ?	3.8 3.5	4.5 3	3.3 2.1	7.9 7.2
Head projections	One pair, anterolateral	Absent	One anterolateral	pair, Absent	One, anterior projection (=rostrum)	Absent	Absent	Absent	Absent
Eyes	Present	Without distinguishable ommatidia	Absent	Present	Present	Small thickened anteriorly	Present	Present	Present
Dorsal projections	Absent	Absent	On pereonites 3, 4, 5 in males, on 3 and 5 in females	Absent	On pereonite 3 in males, absent in females	Absent	Absent	Absent	Absent
Pereonite 2 anterolateral projections in males	Present	Absent	Present	Absent	Present	Absent	Present	Present	Absent
Pereonites 3-4 anterolateral projections in males	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
Antenna 1 flagellum, no. of articles in males	?6	8-9	4-5	5-6	10	2	5	5	5
Pereopods 3 and 4, no. of articles	1	2	1	1	1	1	1	1	1
Pereopod 5, no. of articles	2	2	2	2	2	2	2	1	3
Male abdominal appendages	1-articulate	2-articulate	Vestigial	1-articulate	1-articulate	Vestigial	1-articulate	2 pairs, 1-articulate	Vestigial

Remarks. The genus *Liropus*, established by Mayer (1890) now includes nine species: *Liropus africanus* Mayer, 1920; *Liropus azorensis* Guerra-García, 2004; *Liropus cachuchoensis* Guerra-García, Sorbe & Frutos., 2008; *Liropus elongatus* Mayer, 1890 (type species); *Liropus gracilis* Chevreux, 1927; *Liropus japonicus* Mori, 1995; *Liropus minimus* Mayer, 1890; *Liropus minusculus* n. sp. and *Liropus nelsonae* Guerra-García, 2003. A morphological comparison among *Liropus* species is given in Table 1. The new species *Liropus minusculus* can be distinguished from all its congeners mainly by the following characteristics: presence of anterolateral projections on pereonites 2, 3 and 4 in males, pereopod 5 one-articulate and abdomen with two pairs of abdominal appendages in males. *L. minusculus* is the smallest *Liropus* species, although *L. africanus*, *L. japonicus* and *L. minimus* are also characterised by small body size.

Liropus minusculus represents the first record of the genus *Liropus* in the north-east Pacific (Fig. 5). The only other species described from the Pacific Ocean is *L. japonicus* from the north-west Pacific. The remaining species have been collected from Atlantic or Mediterranean waters. The genus is mainly distributed in the border area between the tropical and temperate zones. Further studies are necessary to check if the genus *Liropus* is also distributed along the Indian Ocean and to elucidate the global distribution of *Liropus* species.

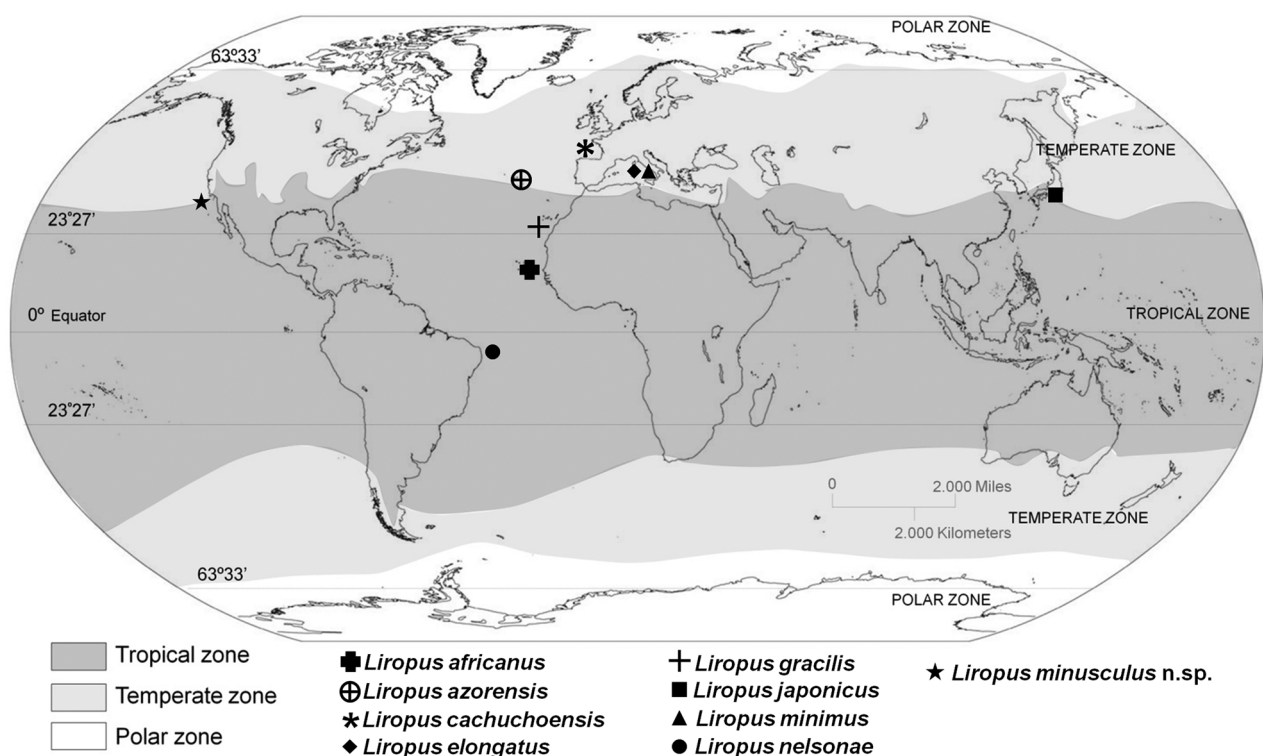


FIGURE 5. Distribution map of *Liropus* species. Information has been obtained from Mayer (1890, 1903, 1920), Chevreux (1927), Krapp-Schickel (1993), Mori (1995), Guerra-García (2003, 2004) and Guerra-García *et al.* (2008).

Illustrated key to the world species of *Liropus* Mayer, 1890

(Modified from Guerra-García, 2004 and Guerra-García *et al.*, 2008)

See figure 6, which illustrates the morphological characters used in conjunction with the key

- | | | | |
|-----|---|-------|---|
| 1a. | Pereopods 3 and 4 two-articulate | ..... | <i>L. azorensis</i> Guerra-García, 2004 |
| 1b. | Pereopods 3 and 4 one-articulate | ..... | 2 |
| 2a. | Pereopod 5 one-articulate | ..... | <i>L. minusculus</i> n.sp. |
| 2b. | Pereopod 5 two or three-articulate | ..... | 3 |
| 3a. | Pereopod 5 three-articulate | ..... | <i>L. nelsonae</i> Guerra-García, 2003 |
| 3b. | Pereopod 5 two-articulate | ..... | 4 |
| 4a. | Flagellum of antenna 1 two-articulate. | ..... | <i>L. japonicus</i> Mori, 1995 |
| 4b. | Flagellum of antenna 1 more than two-articulate | ..... | 5 |
| 5a. | Head with one or two projections | ..... | 6 |

5b.	Head smooth	.....	8
6a.	Head with a single anterior projection (= rostrum).	.....	<i>L. gracilis</i> Chevreux, 1927
6b.	Rostrum absent, but a pair of anterolateral projections present	.....	7
7a.	Body smooth dorsally	.....	<i>L. africanus</i> Mayer, 1920
7b.	Dorsal projection on pereonites 3, 4 and 5 in males, and 3 and 5 in females	.....	<i>L. cachuchoensis</i> Guerra-García, Sorbe & Frutos, 2008
8a.	Gnathopod 2 basis with a basal constriction	.....	<i>L. minimus</i> Mayer, 1890
8b.	Gnathopod 2 basis with parallel margins, lacking constriction.	.....	<i>L. elongatus</i> Mayer, 1890

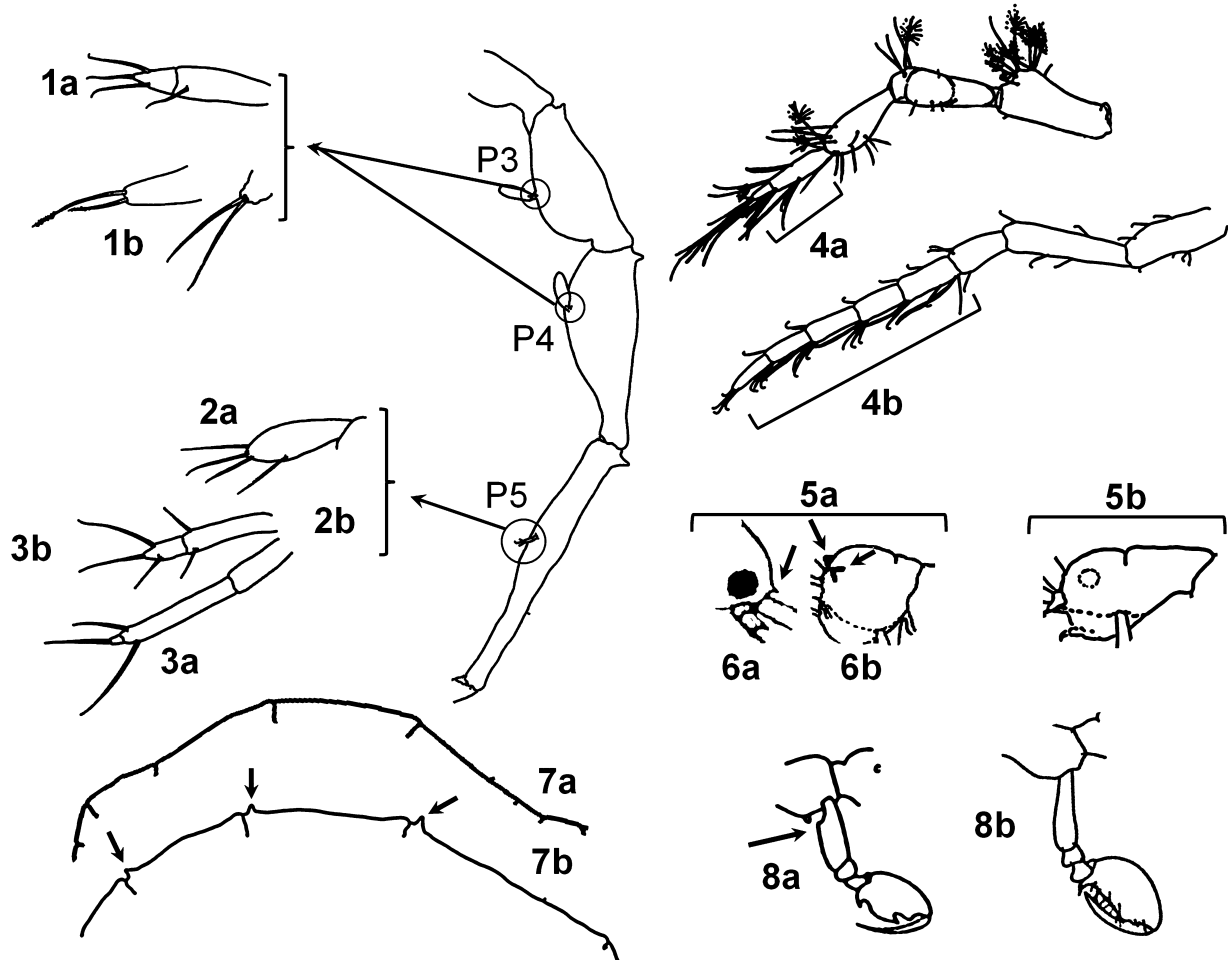


FIGURE 6. Morphological characters used to identify species of *Liropus*. Numbers (1–8) and letters (a, b) correspond to the couplets of the key provided. Figures modified from Chevreux (1927), Krapp-Schickel (1993), Mori (1995), Guerra-García (2003, 2004) and Guerra-García *et al.* (2008).

Acknowledgements

Financial support of this study was provided by the University of Seville through the programme *Plan Propio de Investigación (Ayudas para la Movilidad de Personal dedicado a la Investigación, Modalidad A)*. We are grateful to the Canadian Museum of Nature for the assistance given to JMGG during his work trip in October 2010, including Judith Price for cataloguing the type material. For comparative specimen loans, we thank D. Defaye (MNHN), E. Nelson (USNM) and M. Villena (MNCN).

References

- Chess, J.R. (1989) *Aciconula acanthosoma*, new species, a caprellid amphipod from Southern California, with notes on its ecology. *Journal of Crustacean Biology*, 9 (4), 662–665.
<http://dx.doi.org/10.1163/193724089x00656>

- Chevreaux, E. (1927) Crustacés Amphipodes. Expéditions Scientifiques du *Travailleur* et du *Talisman* pendant les années 1880, 1881, 1882, 1883. *Malacostracés*, 3, 1–229.
<http://dx.doi.org/10.5962/bhl.title.13677>
- Dougherty, E.C. & Steinberg, J.E. (1953) Notes on the skeleton shrimps (Crustacea: Caprellidae) of California. *Proceedings of the Biological Society of Washington*, 66, 39–50.
- Guerra-García, J.M. (2003) Two new species of deep-water caprellids (Crustacea: Amphipoda) from northeastern Brazil. *Cahiers de Biologie Marine*, 44, 171–184.
- Guerra-García, J.M. (2004) Deep-sea Caprellidea (Crustacea: Amphipoda) from Azores with the description of three new species. *Zoosystema*, 26 (2), 235–262.
<http://dx.doi.org/10.1016/j.ode.2006.04.002>
- Guerra-García, J.M., Sorbe, J.C. & Frutos, I. (2008) A new species of *Liropus* (Crustacea, Amphipoda, Caprellidae) from Le Danois bank (southern Bay of Biscay). *Organisms, Diversity and Evolution*, 7, 253e1–253e12.
- Jensen, M.P. (1969) *The ecology and taxonomy of the Caprellidae (Order: Amphipoda, Suborder: Caprellidea) of the Coos Bay, Oregon area*. PhD dissertation. Department of Entomology, University of Minnesota, 248 pp.
- Krapp-Schickel, T. (1993) Suborder Caprellidea. In: Ruffo, S. (Ed.), *The Amphipoda of the Mediterranean*. Mémoires de l'Institut océanographique de Monaco, 13, 773–809.
- Laubitz, D.R. (1970) Studies on the Caprellidae (Crustacea : Amphipoda) of the American North Pacific. *National Museum of Natural Sciences, Ottawa, Publications in Biological Oceanography*, 1, 1–89.
- Leach, W.E. (1814) Crustaceology, In: Brewster, D. (Ed) *The Edinburgh Encyclopaedia*, Edinburgh, 7 (1/2), pp. 383–434.
- Lowry, J.K. & Myers, A.A. (2013) A Phylogeny and Classification of the Senticaudata subord. nov. (Crustacea: Amphipoda). *Zootaxa*, 3610, 1–80.
<http://dx.doi.org/10.11646/zootaxa.3610.1.1>
- Marelli, D.C. (1981) New records for Caprellidae in California, and notes on a morphological variant of *Caprella verrucosa* Boeck, 1871. *Proceedings of the Biological Society of Washington*, 94 (3), 654–662.
- Martin, D.M. (1977) A survey of the family Caprellidae (Crustacea: Amphipoda) from selected sites along the northern California coast. *Bulletin, Southern California Academy of Sciences*, 76, 146–167.
- Mayer, P. (1882) Caprelliden. *Fauna und Flora des Golfes von Neapel*, 6, 1–201.
<http://dx.doi.org/10.5962/bhl.title.53624>
- Mayer, P. (1890) Die Caprelliden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Nachtrag zur Monographie derselben. *Fauna und Flora des Golfes von Neapel*, 17, i-viii + 1–157.
<http://dx.doi.org/10.5962/bhl.title.53624>
- Mayer, P. (1903) Die Caprellidae der Siboga-Expedition. *Siboga-Expeditie*, 34, 1–160.
<http://dx.doi.org/10.5962/bhl.title.53742>
- Mayer, P. (1920) Crustacea V: Laemodipoda. In: Michaelsen, W. (Ed.), *Beiträge zur Kenntnis der Meeresfauna West-afrikas*, Vol. 3. pp. 13–15.
- McCain, J.C. & Steinberg, J.E. (1970) *Crustaceorum Catalogus: Amphipoda I, Caprellidea I, Family Caprellidae*. Dr. W. Junk N.V., Den Haag, 78 pp.
- Mori, A. (1995) A new species of *Liropus* (Crustacea: Amphipoda: Caprellidea) from off Minabe, Kii Peninsula, Central Japan. *Publications of the Seto Marine Biology Laboratory*, 36, 329–337.
- Watling, L. & Carlton, J.T. (2007) Caprellidae. In: Carlton, J.T. (Ed.), *The Light and Smith Manual of the Intertidal invertebrates from central California to Oregon*. University of California Press, Berkeley and Los Angeles, California, pp 618–628.