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A new species of *Liropus* (Crustacea, Amphipoda, Caprellidae) from Le Danois bank (southern Bay of Biscay)

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Abstract

A new species of the genus *Liropus* (Crustacea, Amphipoda, Caprellidae) is described based on specimens collected from Le Danois bank ('El Cachucho' fishing grounds), Bay of Biscay. *Liropus cachuchoensis* n. sp. can be distinguished from all its congeners mainly by the absence of eyes and by the presence of a dorsal projection proximally on pereonites 3, 4 and 5 in males, on 3 and 5 in females. The new species has been found living on muddy bottoms on the southern flank of the bank and adjacent continental slope, between 619 and 1062 m depth, with a maximum abundance (56.1 ind./100 m²) recorded at 1044–1062 m. Morphological comparisons among the world's members of *Liropus*, a key to species, and data on their distribution are presented.

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Keywords: Crustacea; Amphipoda; Caprellidae; *Liropus*; New species; Deep-sea

Introduction

Caprellids are small marine crustaceans living from intertidal areas to deep-sea waters (McCain 1968; Laubitz 1972; Guerra-García 2003). Most caprellids occur epibiotically on various substrates such as algae, seagrasses, hydroids, and bryozoans (Caine 1989), but several species live in more specific associations with invertebrates (Guerra-García 2001). Caprellids from deep waters have been investigated less than those from shallow waters. However, during the last years there has been an attempt to improve the taxonomical and ecological knowledge about deep-sea caprellids (Laubitz

and Sorbe 1996; Guerra-García 2003, 2004; Corbari et al. 2005). In this sense, the caprellids of the Bay of Biscay, the Atlantic Ocean area adjacent to the coasts of northern Spain and western France, have been studied recently. In these surveys, the previously unknown species *Protoaeginella spinipoda* (Laubitz and Sorbe 1996) was described, and the morpho-functional and behavioural adaptations to deep-sea bottoms of the caprellid *Parvipalpus major* Carausu, 1941 were explored using video equipment (cf. Corbari et al. 2005).

During recent suprabenthic sampling on Le Danois bank and its surroundings (top plateau, southern flank and adjacent Cantabrian slope), specimens belonging to an undescribed species of *Liropus* were collected at several stations during the ECOMARG 03 (October 2003) and ECOMARG 04 (April 2004) cruises. In the

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present work, this new species is described and morphologically compared with the other members of the genus *Liropus*. Ecological information on the new species is presented, as well as a key and a distribution map for all *Liropus* species.

Material and methods

During the ECOMARG cruises, the suprabenthic fauna was sampled at several stations from Le Danois bank (Fig. 1, Table 1), using a suprabenthic sled equipped with four plankton nets (0.5 mm mesh size) and with an opening–closing system activated by contact with the sea floor (for full description see Sorbe 1983). The superimposed nets allow quantitative sampling of the motile fauna in two water layers (0–50 and 50–100 cm; lower/upper net codes: a–b/c–d) above the sea floor. The sled was towed at approx. 1.5 knots over the bottom during each haul. The volume of water filtered by the nets (in m³) and the bottom area sampled by the sled (in m²) were estimated from the values given by a TSK flowmeter placed in the opening of the right upper net (see also Cunha et al. 1997). The collected suprabenthic fauna was fixed on board with 10% neutral formalin, then sorted under a dissecting microscope. The *Liropus* specimens were identified and counted. Their abundance was expressed as the number of individuals per 100 m³ for the 0–50 and 50–100 cm water layers, and as the number of individuals per 100 m² for the 0–100 cm water layer.

Selected specimens were dissected under an Olympus dissecting microscope. All dissected appendages were mounted in polyvinyl–lactophenol. The figures were drawn using a Leica compound microscope equipped with a camera lucida.

For morphological comparisons, material from the Muséum National d'Histoire Naturelle (MNHN), Paris, and from the United States National Museum (USNM), Washington, DC, was examined. Specimens of the new species have been deposited in the Museo Nacional de Ciencias Naturales (MNCN), Madrid, and at MNHN.

The phylogeny and higher classification of the caprellids is still being debated (see Laubitz 1993; Takeuchi 1993). Recently, Myers and Lowry (2003) have proposed a new phylogeny and classification for the suborder Corophiidea Leach, 1814, which is divided into two infraorders, the Corophiida and the Caprellida, based on an hypothesis of the evolution of different feeding strategies. According to this classification, the superfamily Caprelloidea contains five families: Caprellidae, Caprogammaridae, Cyamidae, Dulichiidae, and Podoceridae. The Caprellidae are subdivided into three subfamilies: Caprellinae, Paracercopinae, and Phtisicinae. The genus *Liropus* is included in the subfamily Caprellinae Leach, 1814.

Taxonomic section

Liropus cachuchoensis n. sp.

Etymology

Le Danois bank is locally called 'El Cachucho' by Spanish fishermen (Sánchez et al. 2002).

Material

Holotype: Male (MNCN 20.04/6072); NE Atlantic Ocean, S Bay of Biscay, southern flank of Le Danois bank; ECOMARG 03 cruise, RV 'Vizconde de Eza', 20 October 2003, 14:27–14:58 h, haul coordinates 44°00.39'N 05°09.42'W to 44°01.64'N 05°09.97'W, 854–816 m depth, water layer 0–50 cm above bottom, Arcachon suprabenthic sled, sample reference E03-TS8b; water temperature 12.8 m above bottom (CTD data) 10.3 °C, salinity 35.8‰; sandy mud sediment, median grain size 28.2 µm; silt and clay (<62 µm) 64.93%, fine to medium sand (62–500 µm) 34.42%, coarse sand (>500 µm) 0.65%, organic content 6.26% of sediment dry weight.

Paratypes: Allotype female (MNCN 20.04/6073); three males, three females, one juvenile (MNCN 20.04/6074). Data as for holotype.

Additional material: Two males and two females (MNHN-Am 5835); ECOMARG 04 cruise, RV 'Vizconde de Eza', 14 April 2004, 10:42–11:23 h, haul coordinates 43°58.30'N 05°10.82'W to 43°57.73'N 05°09.25'W, 831–828 m depth, water layer 0–50 cm above bottom, Arcachon suprabenthic sled, sample reference E04-TS2a; water temperature 14 m above bottom (CTD data) 10.2 °C, salinity 35.8‰; sandy mud sediment, median grain size 21.6 µm; silt and clay 69.58%, fine to medium sand 29.07%, coarse sand 1.34%, organic content 7.00% of sediment dry weight.

Diagnosis

Eyes absent. Acute anterolateral projections on head and pereonite 2. Dorsal projection proximally on pereonites 3, 4 and 5 in males, on 3 and 5 in females. Flagellum of antenna 1 with more than two articles. Pereopods 3 and 4 one-articulate; pereopod 5 two-articulate. Male abdominal appendages vestigial.

Description

Male (holotype, 5.3 mm)

Lateral view (Fig. 2): Head rounded, with a pair of acute anterolateral projections; eyes absent. Pereonite 1 fused with head, suture present. Pereonite 2 with a pair of anterolateral projections and another pair of small, acute projections near coxae of gnathopods 2. Pereonites 3, 4 and 5 each with a dorsal projection proximally. Pereonite 5 the longest, pereonite 7 the shortest.

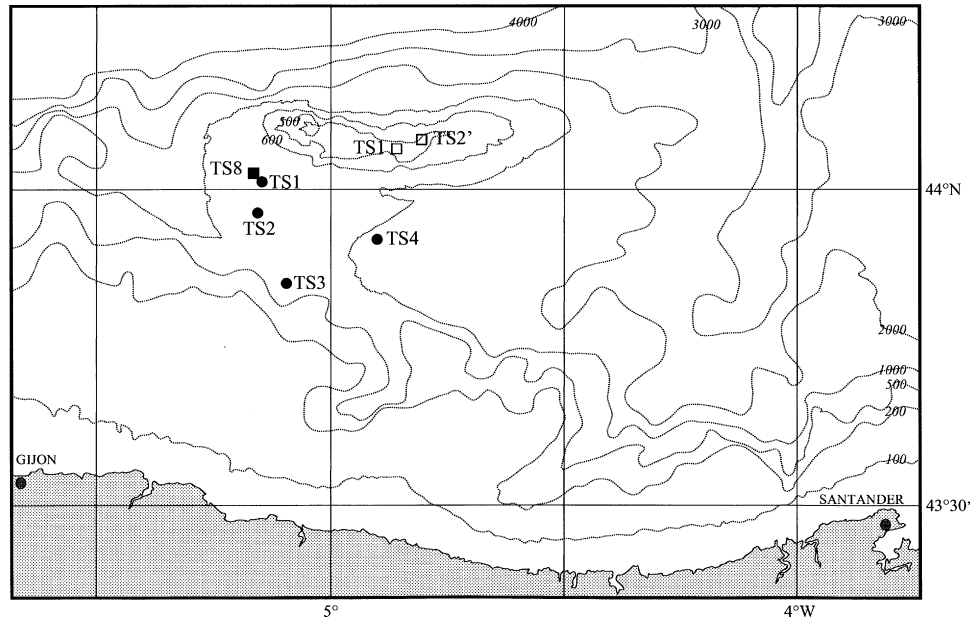


Fig. 1. Geographic locations of seven stations sampled with a suprabenthic sled on Le Danois bank and the adjacent Cantabrian slope during ECOMARG 03 (squares) and ECOMARG 04 (circles) cruises. Solid symbols: samples including *Liropus cachuchoensis* n. sp. Isobaths in metres.

Table 1. Haul characteristics and abundance of the caprellid *Liropus cachuchoensis* n. sp. in the 0–50 cm, 50–100 cm [ind./100 m³], and 0–100 cm [ind./100 m²] near-bottom water layers at seven stations sampled with a suprabenthic sled on Le Danois bank during the ECOMARG 03 and ECOMARG 04 cruises

Haul code	Date (d/m/y)	Time ^a (h:min)	Position ^a		Depth ^b (m)	Abundance		
			N	W		0–50 cm	50–100 cm	0–100 cm
E03-TS1	15/10/03	09:43	44°03.96'	4°52.33'	486/486	0.0	0.0	0.0
E03-TS2'	16/10/03	11:34	44°04.88'	4°49.31'	507/499	0.0	0.0	0.0
E03-TS8	20/10/03	14:27	44°00.39'	5°09.42'	854/816	27.2	2.7	15.2
E04-TS1	13/04/04	13:00	44°00.47'	5°08.08'	828/829	64.9	0.0	32.9
E04-TS2	14/04/04	10:42	43°58.30'	5°10.82'	831/828	8.5	0.3	4.5
E04-TS3	15/04/04	09:34	43°51.47'	5°06.76'	620/619	1.0	0.0	0.5
E04-TS4	16/04/04	12:01	43°54.86'	4°55.10'	1044/1062	105.0	5.7	56.1

^aAt beginning of haul.

^bAt beginning/end of haul.

Gills (Fig. 2): Present on pereonites 3–4, oval, length about two times width.

Mouthparts: Upper lip (Fig. 3D) symmetrically bilobate, without setulae. Mandibles (Figs. 3B, C) with three-articulate palp, second article with a distal seta, distal article with two setae apically; left mandible (Fig. 3B) with incisor and lacinia mobilis six-toothed followed by three setae; incisor of right mandible (Fig. 3C) five-toothed, lacinia mobilis plate-like, followed by two setae; molar flake present on right mandible. Lower lip (Fig. 3E) inner and outer lobes well demarcated, without setae; inner lobes almost fused. Maxilla 1 (Fig. 3G) outer lobe carrying six robust setae; distal article of palp with three apical and two medial setae. Maxilla 2 (Fig. 3F) inner lobe trapezoidal, carrying four distal setae; outer

lobe rectangular, with five apical setae. Maxilliped (Fig. 3A) inner plate oval, carrying three setae and a nodular seta; outer plate oval, with two setae apically and three laterally; palp four-articulate, second article with two lateral setae, third article with three distal setae, distal article with tiny setulae distally.

Antennae: Antenna 1 (Fig. 4A) about one-fifth of body length; proximal article of peduncle without projection; flagellum five-articulate. Antenna 2 (Fig. 4B) about two thirds of antenna 1; proximal peduncular article with acute projection distally; swimming setae absent; flagellum two-articulate.

Gnathopods: Gnathopod 1 (Fig. 4C) basis as long as ischium, merus and carpus combined; propodus palm with two rows of bifid grasping spines, grasping margin



Fig. 2. *Liropus cachuchoensis* n. sp., lateral views of holotype male (MNCN 20.04/6072) and allotype female (MNCN 20.04/6073). Scale bar: 1 mm.

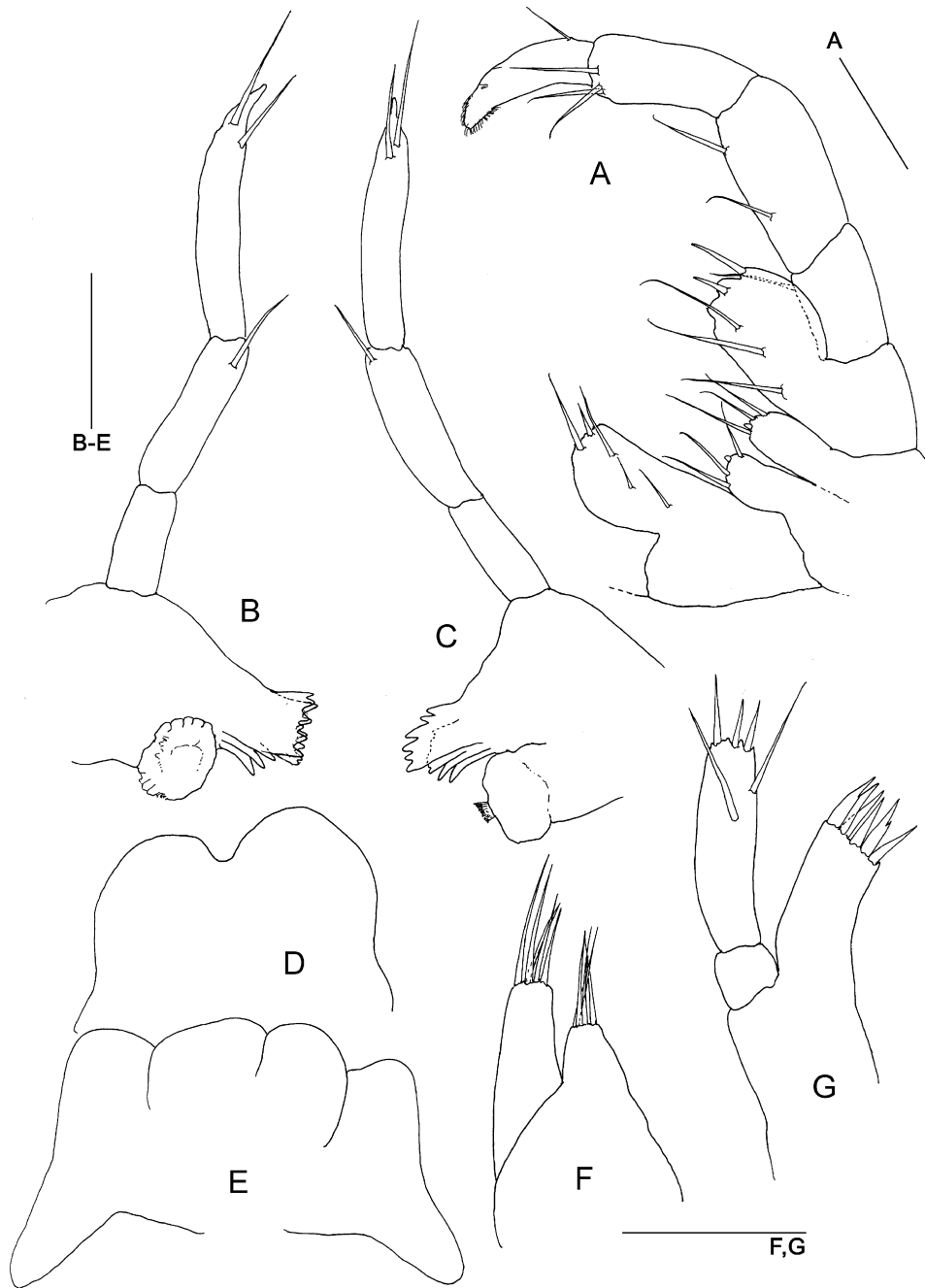


Fig. 3. *Liropus cachuchoensis* n. sp., mouthparts of holotype male (MNCN 20.04/6072); (A) maxilliped, (B) left mandible, (C) right mandible, (D) upper lip, (E) lower lip, (F) Maxilla 2, and (G) Maxilla 1. Scale bars: 0.05 mm.

smooth. Gnathopod 2 (Fig. 4D) inserted on anterior half of pereonite 2 (Fig. 2); small, acute lateral projection close to coxa (Fig. 2); basis about two-thirds of pereonite 2 in length; ischium rectangular; merus rounded; carpus short and triangular; propodus oval, as long as basis; palm with proximal projection carrying two spines, followed by serrate margin and small U-shaped notch; dactylus with dispersed setulae.

Pereopods: Pereopods 3 (Fig. 5A) and 4 (Fig. 5B) very tiny, one-articulate, each with two setae distally.

Pereopod 5 (Fig. 5C) two-articulate, attached at middle of pereonite 5 (Fig. 2); distal article twice as long as proximal, with six distal setae. Pereopod 6 (Fig. 5D) attached to posterior end of pereonite 6 (Fig. 2), six-articulate, basis without carina, ischium short and rectangular, propodus and carpus palms each carrying a row of robust setae. Pereopod 7 (Fig. 5E) slightly larger than pereopod 6, but similar in features.

Penes (Fig. 5F): Situated medially, oval, length about 1.5 times width.

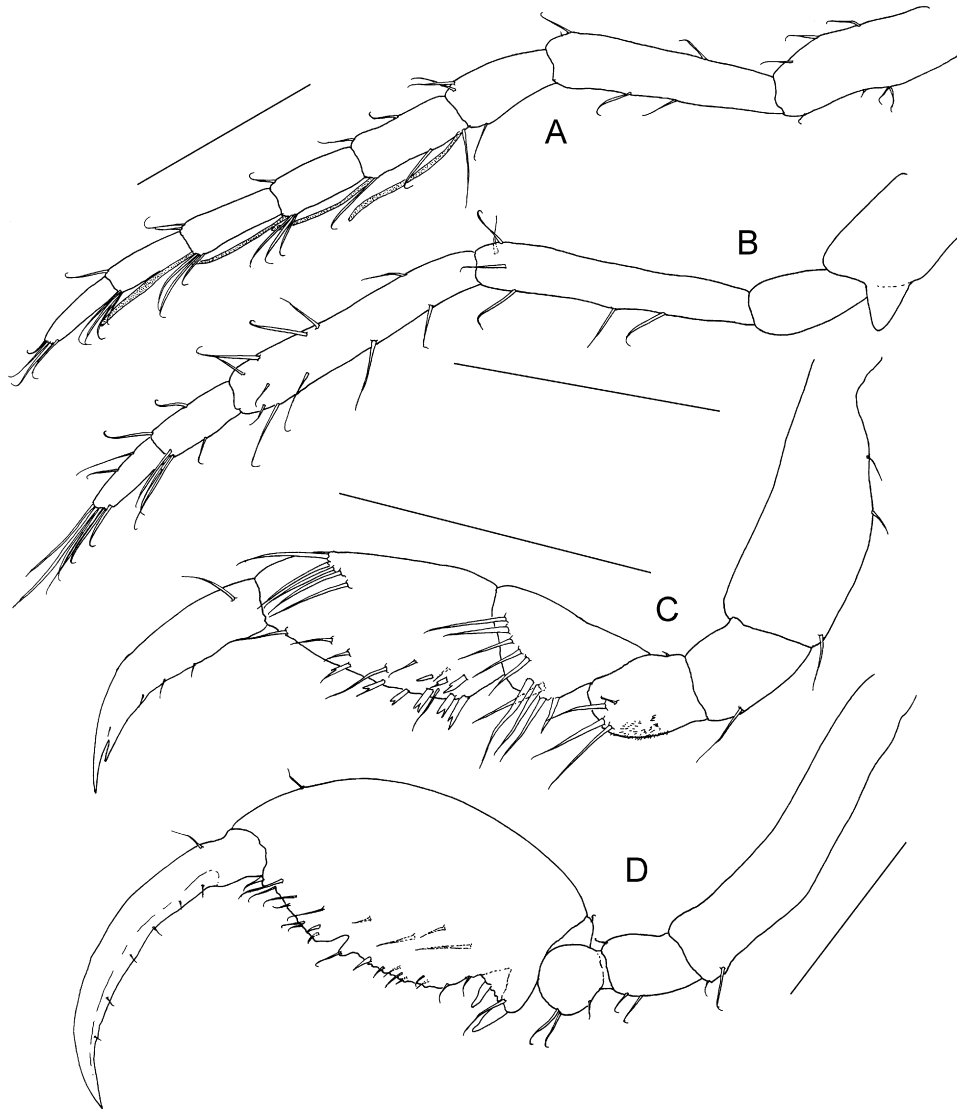


Fig. 4. *Liropus cachuchoensis* n. sp., holotype male (MNCN 20.04/6072); (A) Antenna 1, (B) Antenna 2, (C) Gnathopod 1, and (D) Gnathopod 2. Scale bars: 0.2 mm.

Abdomen (Fig. 5F): With two vestigial appendages (degenerated to a tiny bump with setae), a pair of lobes, and a single dorsal lobe carrying two plumose setae.

Female (allotype, 4.6 mm)

Similar to male except as follows: Oostegites present on pereonites 3 and 4, setose on pereonite 3 (Fig. 2); pereonite 2 lacking lateral projections, pereonite 4 lacking a dorsal projection proximally; abdomen (Fig. 5G) with pair of lateral lobes carrying one seta each, and with single dorsal lobe carrying two setae.

Distribution

Known from Le Danois bank only.

Remarks

The genus *Liropus*, established by Mayer (1890), presently includes eight species: *Liropus africanus* Mayer, 1920, *Liropus azorensis* Guerra-García, 2004, *L. cachuchoensis* n. sp., *Liropus elongatus* Mayer, 1890, *Liropus gracilis* Chevreux, 1927, *Liropus japonicus* Mori, 1995, *Liropus minimus* Mayer, 1890, and *Liropus nelsonae* Guerra-García, 2003. A morphological comparison among *Liropus* species is given in Table 2. *L. cachuchoensis* n. sp. can be distinguished from all its congeners mainly by the following characteristics: absence of eyes, presence of a dorsal projection proximally on pereonites 3, 4 and 5 in males, on 3 and 5 in females. *L. cachuchoensis* and *L. africanus* are the only *Liropus* species with a pair of acute anterolateral projections on the head. Lateral projections on pereonite 2 are only present in *L. cachuchoensis* n. sp., *L. africanus*

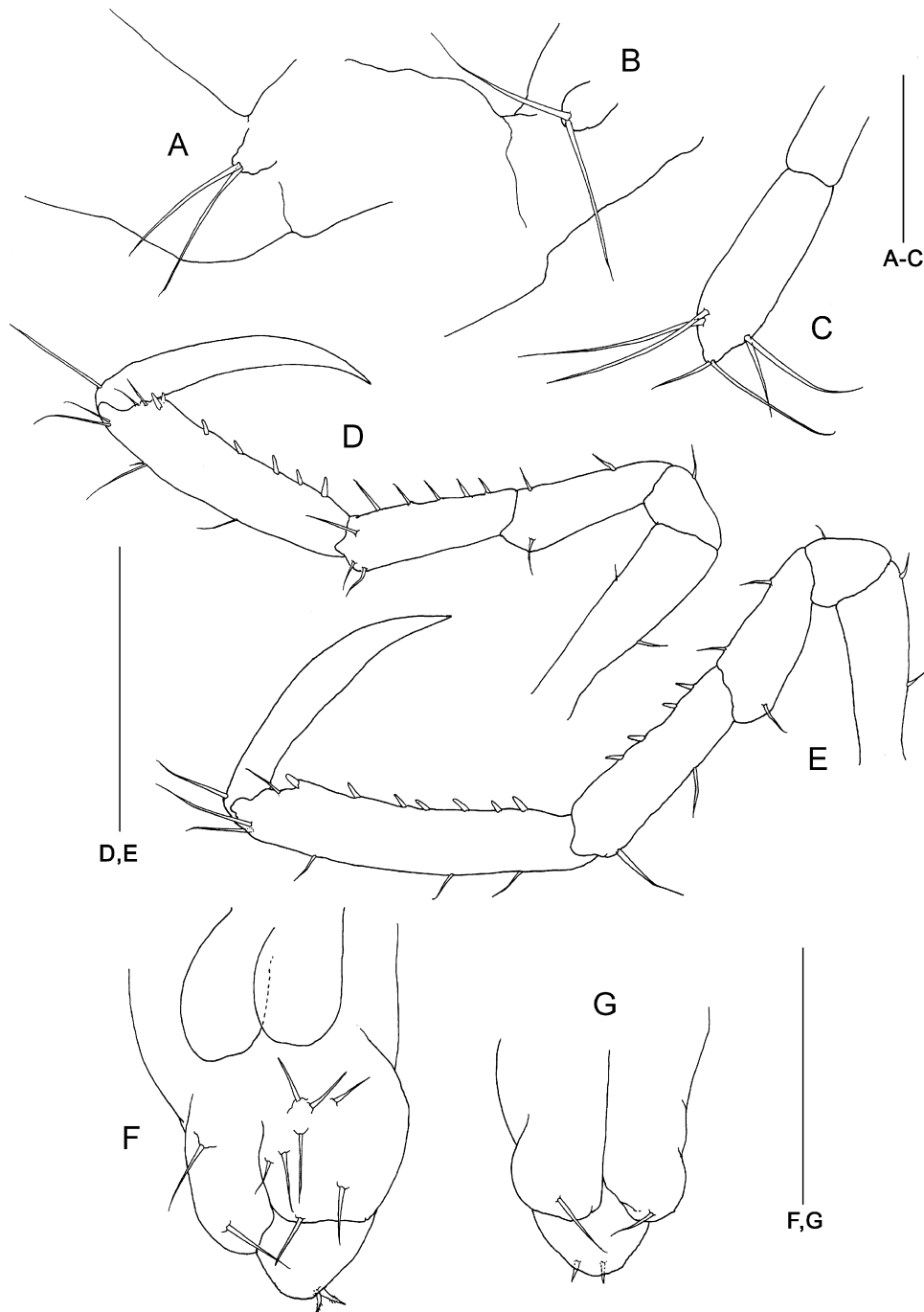


Fig. 5. *Liropus cachuchoensis* n. sp. (A–F) Holotype male (MNCN 20.04/6072), (G) Allotype female (MNCN 20.04/6073); (A) Pereopod 3, (B) Pereopod 4, (C) Pereopod 5, (D) Pereopod 6, and (E) Pereopod 7, (F, G) Abdomen. Scale bars: A–C, F, G = 0.1 mm; D, E = 0.3 mm.

and *L. gracilis*. Vestigial male abdominal appendages also occur in *L. japonicus* and *L. nelsonae*.

Due to their known geographic distribution (Fig. 6), *L. elongatus* and *L. minimus* are considered as Mediterranean endemics. These two species are morphologically very similar (Table 2); however, there are several differences: on pereopods 6 and 7 the propodus has a

row of setae along the palm in *L. minimus*, versus one grasping spine proximally in *L. elongatus*; the gnathopod 2 basis has a basal constriction in *L. minimus* that is absent in *L. elongatus*. With the exception of *L. japonicus* from the Pacific Ocean, the remaining species of *Liropus* have been collected from the Atlantic Ocean (Fig. 6).

Table 2. Comparison of selected characters among the species of *Liropus*, based on data from Mayer (1890, 1903, 1920), Chevreux (1927), Krapp-Schickel (1993), Mori (1995), and Guerra-García (2003, 2004), as well as on the following museum material: *L. africanus* (MNHN-Am 5028), *L. azorensis* (MNHN-Am 5259, 5260, 2949, 2956), *L. cachuchoensis* n. sp. (present study), *L. elongatus* (MNHN-Am 5082), *L. gracilis* (MNHN-Am 5245), *L. nelsonae* (USNM 1008383, 1008384, 1008385)

	<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. nelsonae</i>
Body length (mm)								
Male	3.5	6.7	5.3	5.0	12	3.8	4.5	7.9
Female	?	5.8	4.6	4.5	?	3.5	3	7.2
Head projections	One pair, anterolateral Present	Absent	One pair, anterolateral Absent	Absent Present	One, anterior (= rostrum) Present	Absent	Absent Present	Absent Present
Eyes		Without distinguishable ommatidia				Small, thickened anteriorly		
Dorsal projections	Absent	Absent	On pereonites 3–5 in male, on 3 and 5 in female Present	Absent	On pereonite 3 in male, absent in female Present	Absent	Absent	Absent
Pereonite 2 anterolateral projections	Present	Absent		Absent		Absent	Absent	Absent
Antenna 1 flagellum, no. of articles	?6	8–9	4–5	5–6	10	2	5	5
Pereopods 3 and 4, no. of articles	1	2	1	1	1	1	1	1
Pereopod 5, no. of articles	2	2	2	2	2	2	2	3
Male abdominal appendages	1-Articulate	2-Articulate	Vestigial	1-Articulate	1-Articulate	Vestigial	1-Articulate	Vestigial

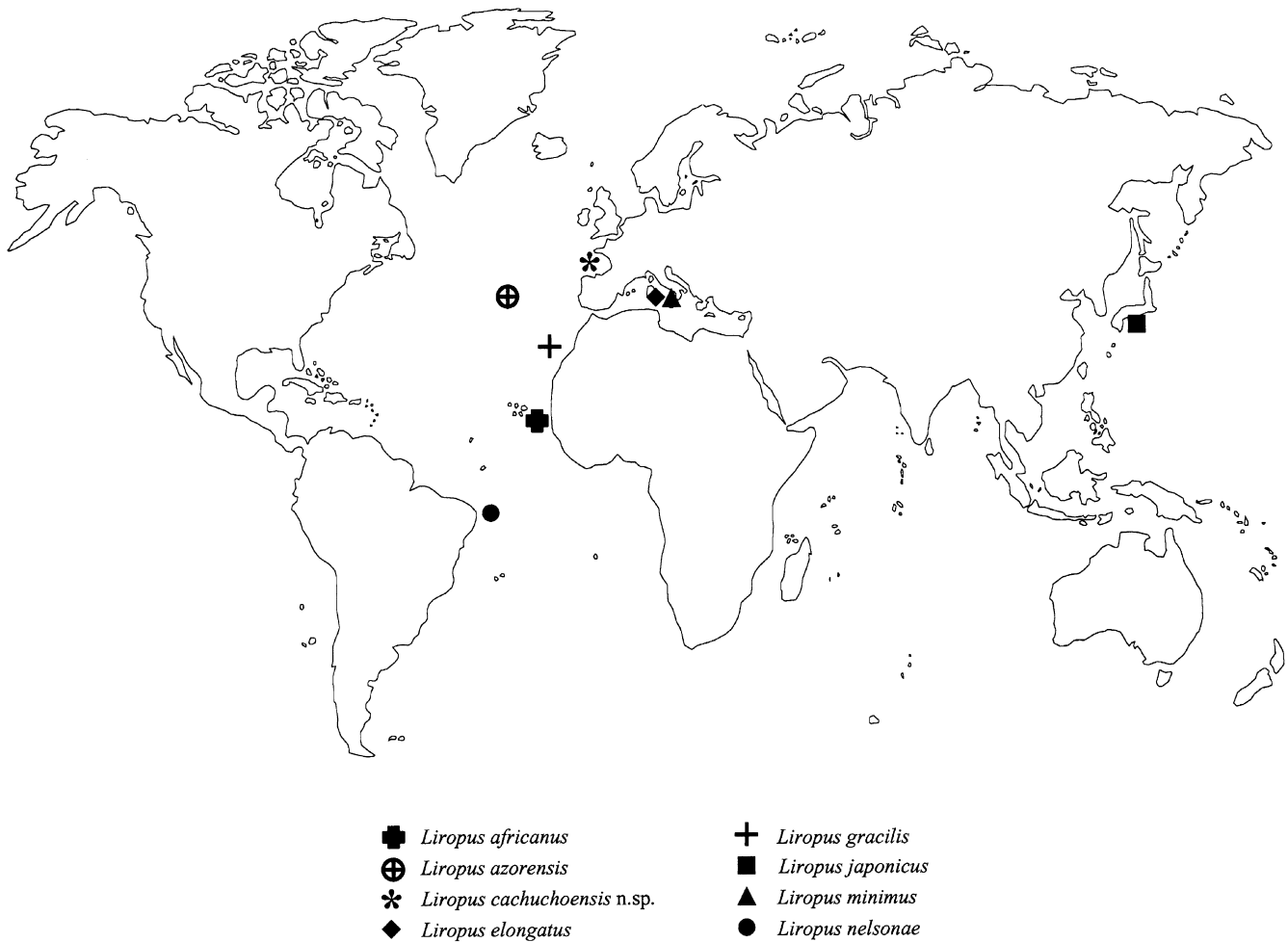


Fig. 6. Distribution of *Liropus* species, based on data from Mayer (1890, 1903, 1920), Chevreaux (1927), Krapp-Schickel (1993), Mori (1995), and Guerra-García (2003, 2004).

Key to the world species of *Liropus* Mayer, 1890

(Modified from Guerra-García 2004).

- 1. Pereopods 3 and 4 two-articulate*L. azorensis* Guerra-García, 2004
- Pereopods 3 and 4 one-articulate2
- 2. Pereopod 5 three-articulate*L. nelsonae* Guerra-García, 2003
- Pereopod 5 two-articulate3
- 3. Flagellum of antenna 1 two-articulate*L. japonicus* Mori, 1995
- Flagellum of antenna 1 with more than two articles4
- 4. Head with one or two projections5
- Head without projections7
- 5. Head with a single anterior projection (= rostrum)*L. gracilis* Chevreaux, 1927
- Head with a pair of anterolateral projections6
- 6. Body smooth dorsally. Eyes present*L. africanus* Mayer, 1920
- Dorsal projections present on pereonites 3, 4 and 5 in males, on 3 and 5 in females. Eyes absent*L. cachuchoensis* n. sp.
- 7. Propodus of pereopods 6 and 7 with row of setae along palm. Gnathopod 2 basis with a basal constriction*L. minimus* Mayer, 1890
- Propodus of pereopods 6 and 7 with one grasping spine proximally. Gnathopod 2 basis with parallel margins*L. elongatus* Mayer, 1890

Ecological notes

Le Danois (1948) was the first author to provide information on trawled epibenthic communities from the area now known as Le Danois bank, and to describe the bathymetric distribution of some macrobenthic species all along the 5°W transect on the Cantabrian margin. He mentioned the existence of *Dendrophyllia cornigera* (Lamarck, 1816) coral reefs on both, the northern and southern flanks of the bank (from its top plateau down to about 800 m depth) as well as on the adjacent continental slope. However, such deep coral reefs were not observed during the recent ECOMARG investigations (trawl samplings, ROV video surveys), though isolated, non-identified coral specimens were observed and collected from place to place (reef disappearance due to trawl destruction?). Observation confirmed by our recent investigations are Le Danois' (1948) reports of a brachiopod facies (*Gryphus vitreus* (Born, 1778)) on the top of the bank, and of a sponge facies (*Phoronema carpenteri* Thomson, 1869) at the bottom of the trench between the bank and the adjacent continental slope. Unfortunately, the motile near-bottom small-crustacean fauna was not taken into consideration in Le Danois' pioneering study.

So far, caprellid species of the genus *Liropus* were never mentioned from the Bay of Biscay, neither in shelf benthic communities, nor from bathyal and abyssal depths (Bachelet et al. 2003). The new species from Le Danois bank is the third caprellid to be discovered at bathyal depths in the Bay of Biscay (no abyssal caprellids have been mentioned from this area); the other two are *P. major* (southern margin of Cap Ferret canyon, Capbreton canyon; depth range 186–924 m), and *P. spinipoda* Laubitz and Sorbe, 1996 (Cap Ferret canyon; depth range 2990–3070 m) (Laubitz and Sorbe 1996; Marquiegui and Sorbe 1999; Corbari and Sorbe 2001).

During the two ECOMARG cruises carried out on Le Danois bank, a total of 10 suprabenthic hauls were carried out at different depths between 486 and 1049 m (top plateau, southern flank of the bank and adjacent Cantabrian slope). Although sorting has not been completed, available results from seven of these hauls allow some ecological information to be given on the new caprellid species. As shown in Fig. 1 and Table 1, *L. cachuchoensis* n. sp. was absent on the top plateau of the bank (near-bottom water temperature 10.9–11.0 °C, salinity: 35.6‰) where the substratum is a mosaic of hard and soft bottoms as revealed by a multibeam echo sounder survey. Within these isolated soft bottom areas where box corer and sled sampling were carried out selectively, the sediment (median grain size 135.8–159.3 µm) is mainly represented by fine sands (73.43–84.31%), characterised by a low pelitic content (<23.4%) probably due to the erosive impact of strong

(seasonal?) near-bottom currents at these depths, and by a lower organic content (<3.11% of sediment dry weight) than in deeper muddy sediments. Such benthic environmental features are apparently not suitable for *L. cachuchoensis*, although these sandy habitats are actually colonized by *P. major*, a caprellid known to develop a peculiar anchorage behaviour on deep soft bottoms (Corbari et al. 2005). As described above, *L. cachuchoensis* shows a general morphology (minuscule pereopod 5 attached at middle of pereonite 5, pereopods 6 and 7 short relative to total body length and with slightly curved dactyls) not indicative of an anchorage behaviour and therefore poorly adapted to facing bottom currents.

From available ECOMARG data, the known bathymetric distribution of *L. cachuchoensis* extends between 619 and 1062 m depth on the southern flank of Le Danois bank (near-bottom water temperature 9.7–10.5 °C, salinity: 35.7–35.8‰), on sediments finer than on the top plateau (median grain size 9–68 µm), characterised by the dominance of the silt and clay fraction (46.52–84.24%) and by a higher organic content (3.88–6.31%) probably related to weaker hydrodynamics. Due to its distributional range, this caprellid population is under the influence of the Mediterranean Overflow Water (Durrieu de Madron et al. 1999), which flows eastward between 700 and 1300 m water depth in the SE Bay of Biscay and is characterised by a salinity maximum and an oxygen minimum at approx. 1000 m water depth. Within the area investigated during the ECOMARG programme, the maximum population abundance was recorded at the greatest depth sampled with the suprabenthic sled (56.1 ind./100 m² in the 0–100 cm near-bottom water layer at 1044–1062 m depth), suggesting that this caprellid probably occurs on deeper muddy bottoms of Le Danois bank. This maximum abundance is much lower than the observed maximum value for *P. major* in the Capbreton canyon (261.9 ind./100 m² at 308–379 m depth; Corbari et al. 2005) but higher than the maximum value reported for *P. spinipoda* in the Cap Ferret canyon (5.3 ind./100 m² at 2990 m depth; Laubitz and Sorbe 1996). As shown in Table 1, most specimens were sampled by the lower nets of the sled and therefore were probably caught when living epibenthically on the sea floor. However, a few (12 out of a total of 164 specimens) were sampled by the upper nets, reflecting a limited but not negligible swimming ability of this species, as has been video-demonstrated experimentally for *P. major* (Corbari et al., 2005).

On present knowledge, *L. cachuchoensis* n. sp. must be considered as endemic to Le Danois bank, as it was never taken in other extensively sampled bathyal areas of the SE Bay of Biscay such as the southern margin of the Cap Ferret canyon (Elizalde et al. 1993; Elizalde 1994; Dauvin and Sorbe 1995), the Capbreton canyon

and its adjacent northern slope (Marquiegui and Sorbe 1999; Corbari and Sorbe 2001). However, future investigations all along the Cantabrian slope may reveal its presence in poorly explored western areas such as the bathyal spurs located off Cabo de Peñas and Cabo Ortegal.

L. cachuchoensis inhabits bathyal sediments. Such habitat has been mentioned also for some other Atlantic *Liropus* species such as *L. azorensis* (NE of Faial Island, 1240–1200 m), *L. gracilis* (off Cap Bojador, 698 m), and *L. nelsonae* (off northeastern Brazil, 943–1007 m). The remaining *Liropus* species occur in shallower waters, inhabiting rocky bottoms (such as *L. minimus* and *L. japonicus*) or sediments with *Posidonia* and *Peyssonnelia* (such as *L. elongatus*) (Krapp-Schickel 1993; Mori 1995). *L. cachuchoensis* has been found in muddy sediments not far from hard bottoms colonised by at least isolated (if not reef-forming) ahermatypic corals. Interestingly, *L. gracilis* and *L. japonicus*, too, have been reported to be sampled with dead coral fragments (Chevreux 1927; Mori 1995).

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