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Two new species of *Pseudoniphargus* (Amphipoda: Pseudoniphargidae) from southern Spain

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Abstract

Two new species of subterranean water amphipod crustaceans of the genus *Pseudoniphargus* (Pseudoniphargidae) are described from gypsum caves of Andalusia, southern Spain. Both species share the extreme elongation of the male third uropod, a striking feature frequently reported in the genus and that seems to have arisen independently in several lineages. These findings raise the number of species of *Pseudoniphargus* known from the area to 17.

Key words: taxonomy, Crustacea, Stygofauna, gypsum caves, Mediterranean

Introduction

The amphipod genus *Pseudoniphargus* Chevreux, 1901, occurs only in subterranean waters of the Mediterranean region and the Atlantic archipelagos of Canaries, Madeira, Açores and Bermuda (Bréhier & Jaume 2009, and references therein, Messouli *et al.* 2006). Most of the 69 species known (Jaume *et al.* 2016) are limnic, but two have been reported from marine sediments adjacent to coastal springs (Stock 1980, Stock & Abreu 1992) and eight from anchialine environments (Sket 1986, Stock *et al.* 1986, Stock 1988, Pretus 1990, Sánchez 1991). Aside of a few exceptions (Stock *et al.* 1986, Notenboom 1987a, Stock 1988, Pretus 1990, Jaume 1991, Sánchez 1991) most species behave as allopatric and show narrow and non-overlapping distributions, frequently apparently reduced to a single cave or well.

In Iberia the genus is highly diversified, but far from being evenly distributed most of the species concentrate in two nuclei. These roughly correspond with the Cantabrian Mountains on the north (13 species; Notenboom 1986) and the Betic ranges on the south and southeast (15 species; Notenboom 1987a). In addition, three species occur on the west coast of the Peninsula (Notenboom 1987b) and there are two records (as *Pseudoniphargus africanus* Chevreux, 1901) from caves in Tarragona, northeast Spain (Margalef 1970). As might be expected from a subterranean thalassoid lineage (Notenboom 1991), the genus is absent from the crystalline core of the Meseta (the central plateau of the Iberian Peninsula), permanently emerged since Palaeozoic times.

The *Pseudoniphargus* cluster from southern Spain was first studied by Notenboom (1987a), who reported the occurrence there of a minimum of 15 species. Notenboom (1988) related this high species diversity to the complex Cretaceous to Late Tertiary tectono-sedimentary history of the Betic ranges, and especially to the intricate and diachronous pattern of retreat of the sea from the numerous marginal and internal basins developed in that area during the Upper Miocene (Martín *et al*. 2014).

Here we describe two new species of *Pseudoniphargus* from two gypsum caves excavated in Triassic evaporites (Keuper) in southern Spain. These caves are not physiographically connected and occur about 70 km apart, one in a olistostrome detached from the Betic ranges and displaced until the Guadalquivir depression, the other one in the Gobantes karst area (Antequera; Málaga). The first cave, known as "Cueva del Yeso", is located 8

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km to the north of the town of Baena (Córdoba) and comprises 2,670 m of surveyed passages (Mora *et al.* 2011). It was formerly reported as "Cueva de las Palomas" by Margalef (1970), who mentioned the occurrence there of *P. africanus* Chevreux, 1901, a species described from Algeria and whose known distribution is limited to that country (see Stock 1980). Since only specimens of the new species appeared in our own collections from the cave, we assume the amphipods referred to by Margalef might correspond also to the new taxon. The second cave, known as "Complejo Romeral", comprises 600 m of surveyed passages (Disney *et al.* 2009).

The two new species share the common display of a male third uropod extremely elongate, a striking troglomorphic feature that seems to have arisen independently in several lineages of the genus (Notenboom 1988). These findings raise the number of species of *Pseudoniphargus* known from southern Spain to 17.

Since 2014 Cueva del Yeso is a show cave opened to the public. We encourage the environmental agency of the Andalusian regional government (Junta de Andalucía) to be aware of the fragility of this habitat and take the appropriate measures to prevent its alteration and assure the conservation of the *Pseudoniphargus* species inhabiting the cave.

Material and methods

Specimens were fixed in the field in 95 % ethanol and treated in the laboratory with lactic acid to remove internal tissues to facilitate observation. Drawings were prepared using a camera lucida on Olympus BH2 and Leica DM 2500 microscopes equipped with Nomarski differential interference contrast. Material preserved on slides was mounted in lactophenol and the coverslips sealed with nail varnish. Body measurements were derived from the sum of the maximum dorsal dimensions of head, pereionites, pleonites and urosomites including telescoped portions, and exclude telson length. Material is deposited in the Crustacea collection of Naturalis Biodiversity Center, Leiden, The Netherlands (RMNH.CRUS).

Taxonomy

Order AMPHIPODA Latreille, 1816

Family Pseudoniphargidae Karaman, 1993

Genus *Pseudoniphargus* Chevreux, 1901

Pseudoniphargus morenoi Stokkan & Jaume, sp. nov.

(Figs 1–6)

Material examined. “Cueva del Yeso” (Baena; Córdoba; Spain). UTM coordinates (Datum ED50): 30S 380474; 4170957; 288 m a.s.l. HOLOTYPE: male 7.7 mm preserved in 70 % ethanol vial [**RMNH.CRUS. A.5082**]; collected by Agustín Castro, 5 August 2001. PARATYPES: Sixteen males, all in 70 % ethanol vial, same data as holotype [**RMNH.CRUS. A.5083**]. Eleven females, all in 70 % ethanol vial, same data as holotype [**RMNH.CRUS. A.5084**]. Eleven specimens, both sexes, in single 70 % ethanol vial, preserved at IMEDEA; collected by Manuel Baena, 11 August 2001.

Diagnosis. Male pleosome smooth, lacking dorsal spur on pleosomite II. Posterodistal angle of epimeral plates not strongly produced into sharp pointed process. Antennule not extremely elongate, shorter than body length. Robust setae of basal endite (= outer lobe) of maxillule coarsely denticulate. Male gnathopod 1 carpus slightly longer than propodus. Posterior margin of propodus of male gnathopod 2 longer than palm margin. Pereiopod 5 shorter than pereiopods 3–4. Basis of pereiopods 5–7 lacking posterodistal lobe. Uropods 1–2 rami without marginal robust setae. Male uropod 3 with very elongate protopod (up to seven times as long as broad) and extremely elongate, upcurved exopod (up to 19.5 times as long as broad). Protopod of male uropod 1 with basofacial robust seta. Female telson 1.2 times broader than long, with distal robust setae shorter than telson itself.

Etymology. Species name after the Cordovan speleologist Antonio Moreno Rosa, in recognition of his contribution to the knowledge of the subterranean environment of the province.

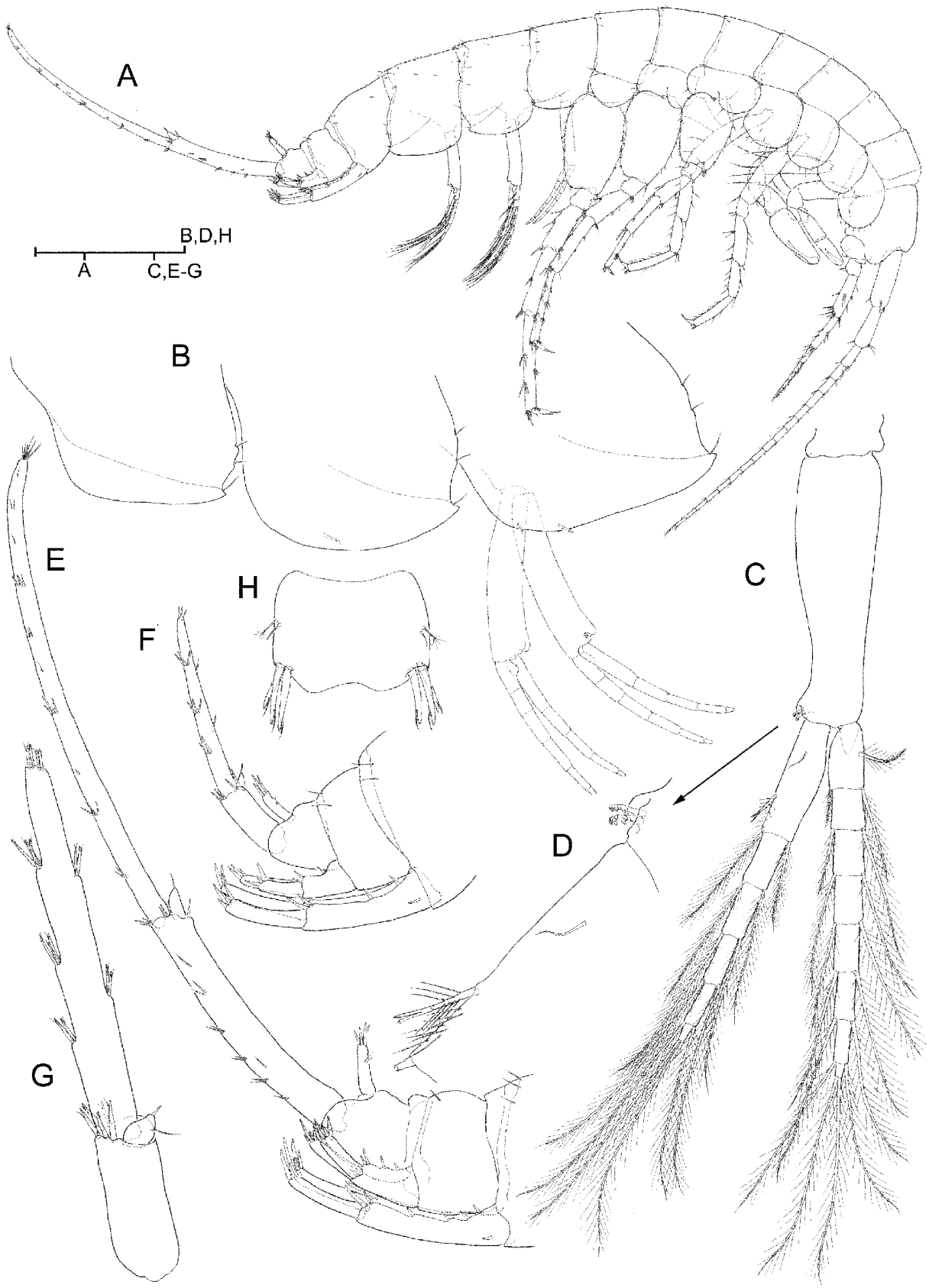

FIGURE 1. *Pseudoniphargus morenoi* **sp. nov.**, male paratype (A–D); female paratype (E–G). A, habitus; B, epimeral plates, lateral view; C, left pleopod 1, anterior; D, detail of distal angle of protopod of pleopod 1 and of armature on medial margin of proximal article of endopod, anterior; E, male urosome, lateral; F, female urosome, lateral; G, female uropod 3, posterior (= dorsal); H, female telson. [Scale bar: 0.5 mm (A–B, E–F); 0.25 mm (C, G–H); 0.125 mm (D)]

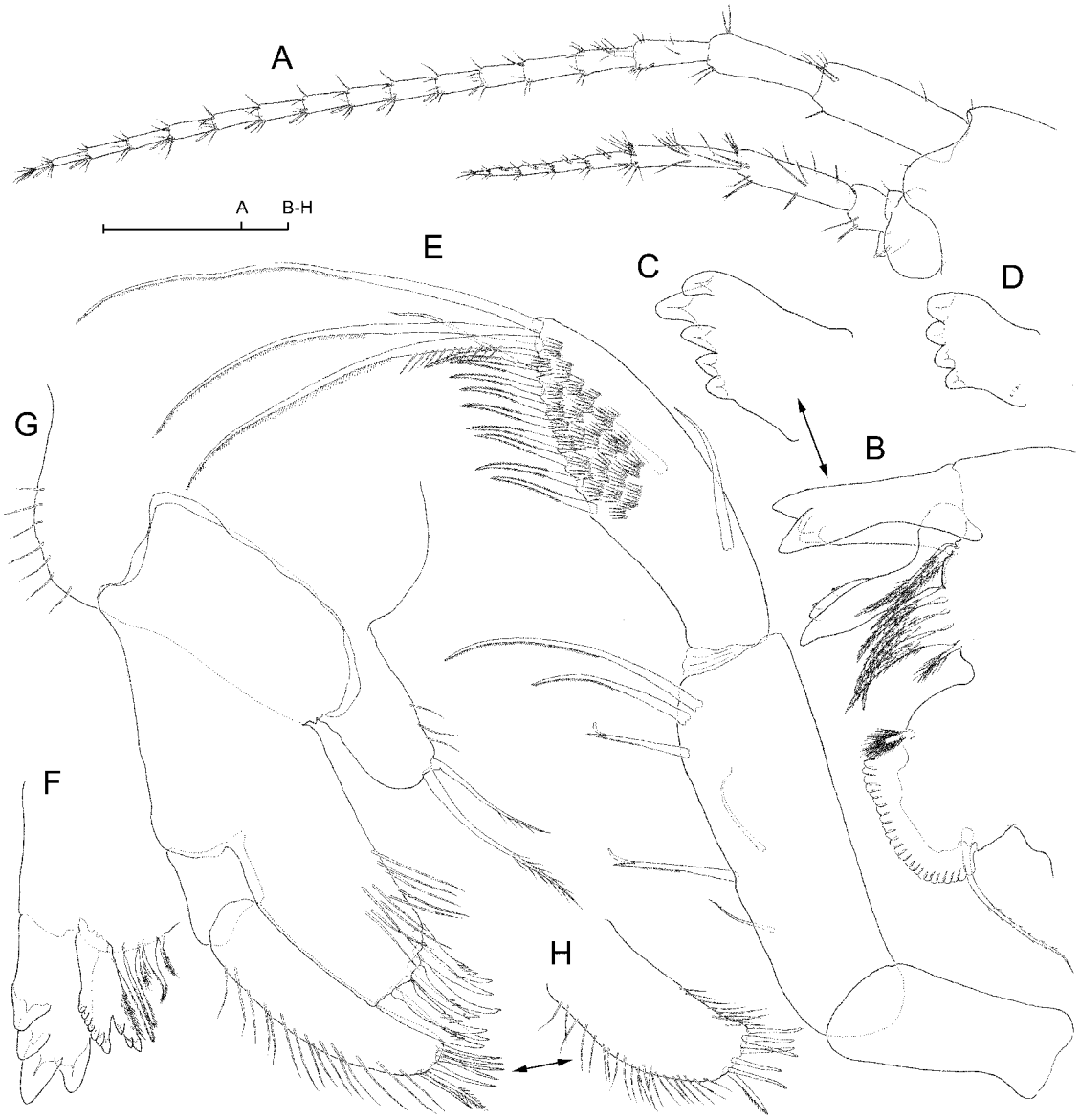

FIGURE 2. *Pseudoniphargus morenoi* **sp. nov.**, male paratype. A, head, left antennule and left antenna, lateral; B, left mandible; C, inset of incisor of latter; D, inset of lacinia; E, left mandibular palp; F, right mandible; G, maxillule; H, detail of distal segment of endopod (= palp) of latter. [Scale bar: 0.05 mm (A); 0.1 mm (B–H)]

Male. *Body* unpigmented, eyeless, up to 8.7 mm long (Fig. 1A). *Head* lacking rostrum, with broadly rounded lateral lobe (Fig. 2A). *Antennule* and *antenna* (Fig. 2A) ordinary. Aesthetascs on articles of main flagellum of antennule each shorter than corresponding article. Relative length of segments 4 and 5 of peduncle of antenna as 1: 0.87; setae on these segments longer than width of corresponding segment. *Labrum* and *paragnaths* ordinary (Fig. 6A, B).

Left mandible (Fig. 2B) with 5-dentate incisor (Fig. 2C); lacinia 4-dentate with row of tiny denticles proximally on anterior surface (Fig. 2D); spine row not continuous, comprising 2+5 pappose elements separated by diastema, proximal-most reduced, two distal-most placed beside each other and not at same plane as rest of components of spine row. Molar process columnar, triturative, with ordinary molar seta; additional short, frayed seta placed adjacent to grinding surface on distal margin. Palp (Fig. 2E) relative length of segments as 0.48: 0.94: 1; second segment with up to six unequal setae on medial surface; distal segment with distomedial patch of spinules and with three long E-setae, up to nine D-setae, 1–2 A-setae and 1–2 B-setae (*sensu* Stock, 1974); one of E-setae with distinct proximal row of long setules on one side; ornamentation of rest of setae as figured.

Right mandible (Fig. 2F) with bifid lacinia 7+3-dentate; one of margins covered with short spinules; spine row comprising five unequal elements as figured; rest of mandible as left counterpart.

Maxillule (Fig. 2G) syncoxal endite (= inner lobe) with two unequal pinnate setae on tip. Basal endite (= outer lobe) with seven robust setae, five of them provided with stout denticles, other two smooth. Endopod (= palp) with six smooth and one pinnate setae on distal segment (Fig. 2H).

Maxilla (Fig. 3A) normal, with coxal endite (= inner lobe) lacking both medial and oblique facial row of setae, and with basal endite (= outer lobe) displaying two separate groups of setae on distal margin; ornamentation of setae as figured.

FIGURE 3. *Pseudoniphargus morenoi* **sp. nov.**, male paratype. A, maxilla; B, left maxilliped, anterior (= dorsal); C, detail of basal endite (= inner plate) of latter; D, inset of distal part of ischial endite (= outer plate); E, inset of distal segments of maxillipedal palp (carpus-dactylus). [Scale bar: 0.05 mm (A); 0.1 mm (B–E)]

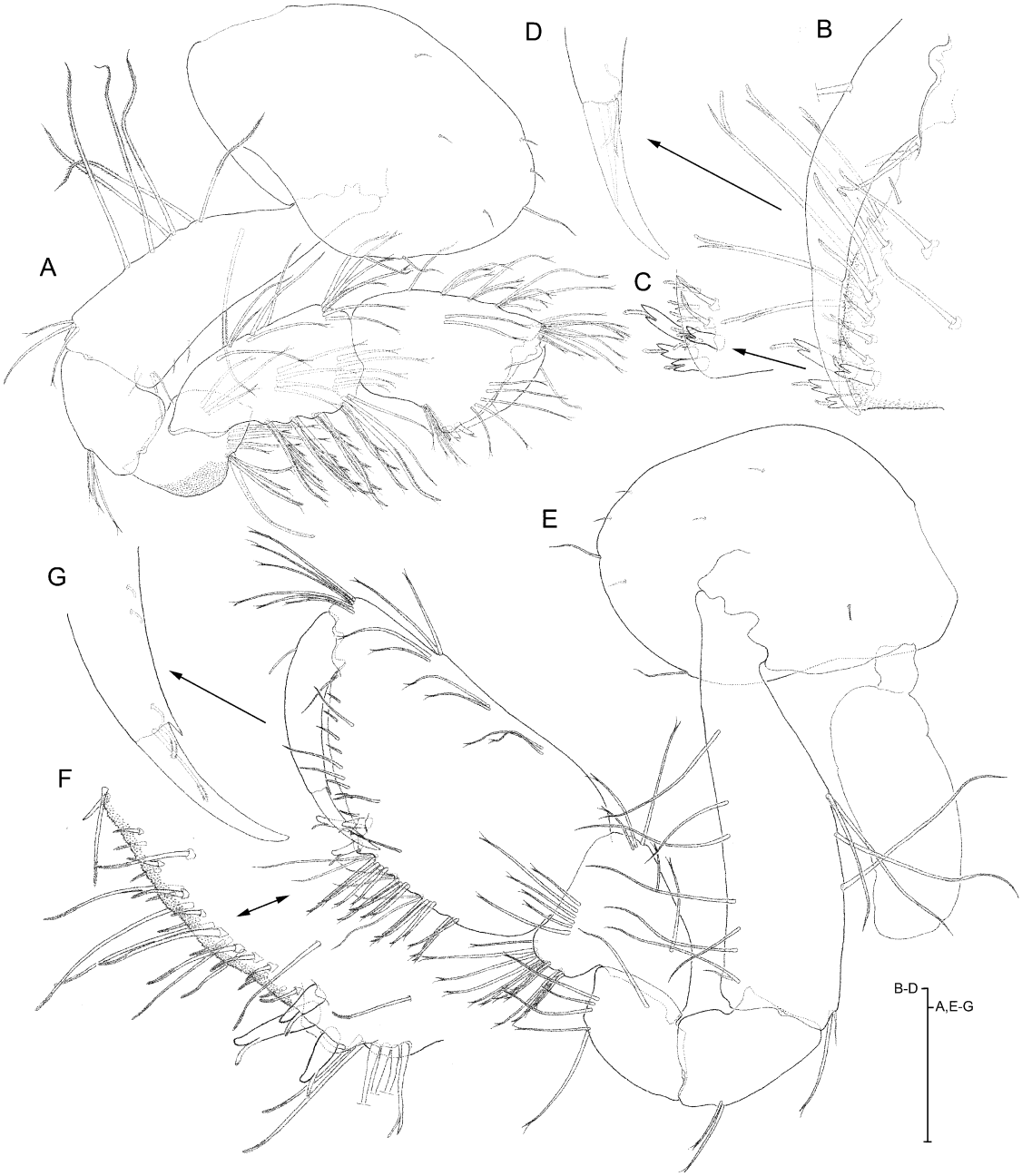

FIGURE 4. *Pseudoniphargus morenoi* **sp. nov.**, male paratype. A, right gnathopod 1 with palm margin armature partially omitted, lateral; B, detail of palm margin of latter, medial; C, detail of palm angle, medial; D, detail of nail, medial; E, right gnathopod 2 with armature of palm margin partially omitted, medial; F, detail of palm margin of latter, medial; G, detail of nail, medial. [Scale bar: 0.25 mm (A, E); 0.1 mm (B, D); 0.125 mm (F, G)]

Maxilliped (Fig. 3B) basal endite (= inner plate) with three short, robust simple setae, three pinnate and one simple seta distally (Fig. 3C). Ischial endite (= outer plate) with up to 17 blade-like, robust pectinate setae along distal and distomedial margin; setae progressively longer and more slender towards distal (Fig. 3D). Carpus slender, about 3.2 times as long as broad (Fig. 3E). Distolateral surface of both propodus and dactylus covered with short denticles. Unguis about as long as dactylus.

Gnathopod 1 (Fig. 4A) carpus slightly longer than propodus. Propodus 1.4 times as long as broad, with maximum width attained at protruding palm angle, placed at 46 % of maximum (=anterior margin) length of segment. Palm angle with 1+3 unequal bifid flagellate robust setae (Fig. 4B, C). Palm margin convex, lined with series of long flagellate stiff setae and short flagellate robust setae distributed as in Fig. 4B, C. Dactylus: unguis length ratio as 1.6; dactylus provided with three distal and one tiny subdistal seta as in Fig. 4D.

Gnathopod 2 (Fig. 4E) carpus short, attaining about 55 % length of propodus. Propodus 1.8 times as long as broad, with sub-parallel anterior and posterior margins; palm angle placed at 56 % of maximum (= anterior margin) length of segment, marked with three unequal flagellate robust setae. Palm margin oblique, convex, with micro-tuberculate integument, armed as in Fig. 4F. Dactylus: unguis length ratio as 2.0. Dactylus with pointed process on postero-distal angle, and with five short unequal setae placed as in Fig. 4G.

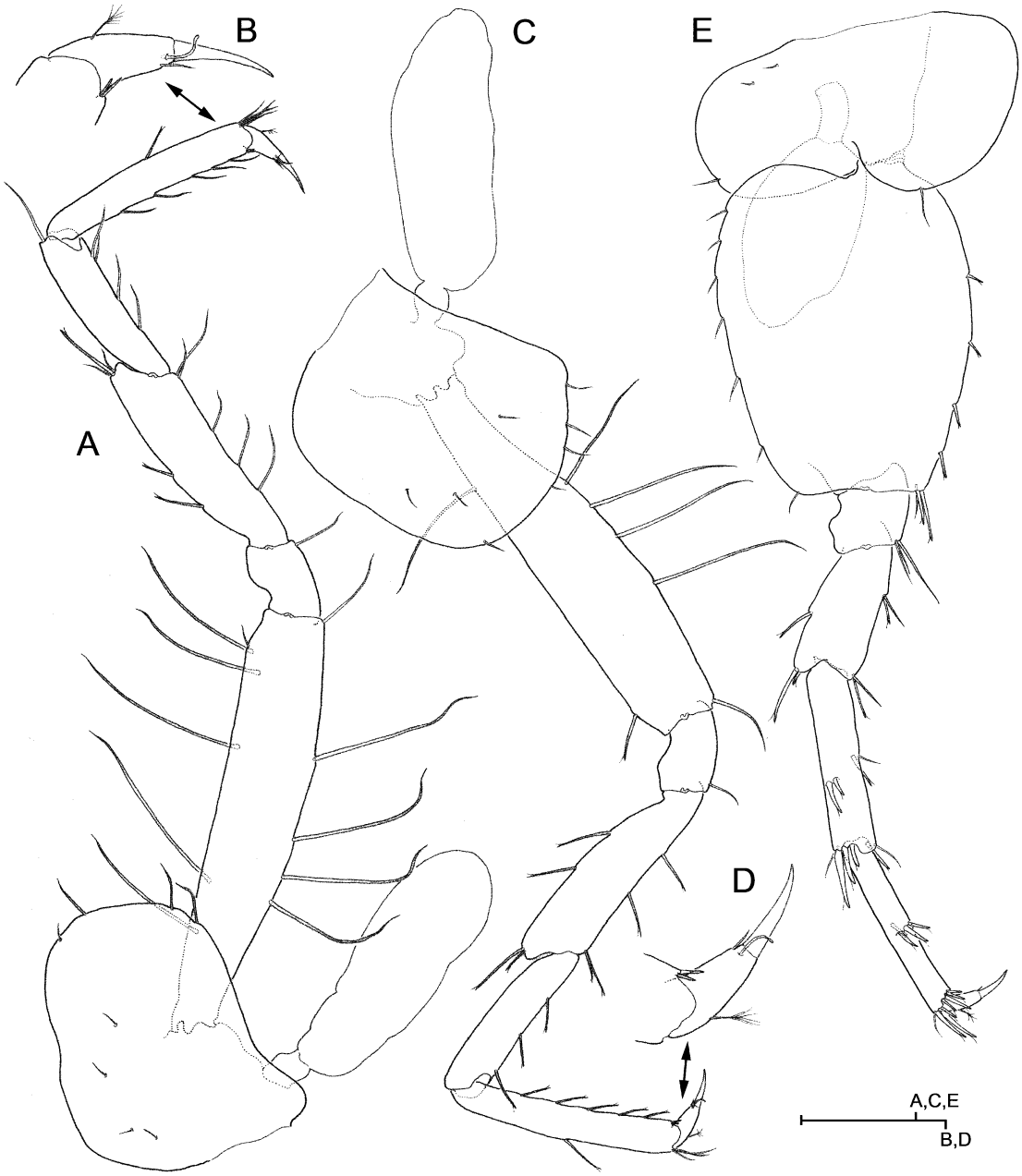

FIGURE 5. *Pseudoniphargus morenoi* **sp. nov.**, male paratype. A, right pereiopod 3, lateral; B, detail of nail of latter; C, left pereiopod 4, lateral; D, detail of nail of latter; E, right pereiopod 5, lateral. [Scale bar: 0.25 mm (A, C, E); 0.125 mm (B, D)]

Pereiopods 3–4 (Fig. 5A, C) subsimilar except for outline of coxal plates; plate of pereiopod 4 with shallowly excavated posterior margin. Unguis shorter than dactylus in both limbs (both with dactylus: unguis length ratio as 1.2; see Fig. 5B, D).

Pereiopod 5 (Fig. 5E) clearly shorter than pereiopod 4. Basis broad, about 1.3 times as long as broad, with convex anterior and posterior margins; postero-distal angle not produced into overhanging lobe. Dactylus: unguis length ratio as 1.1.

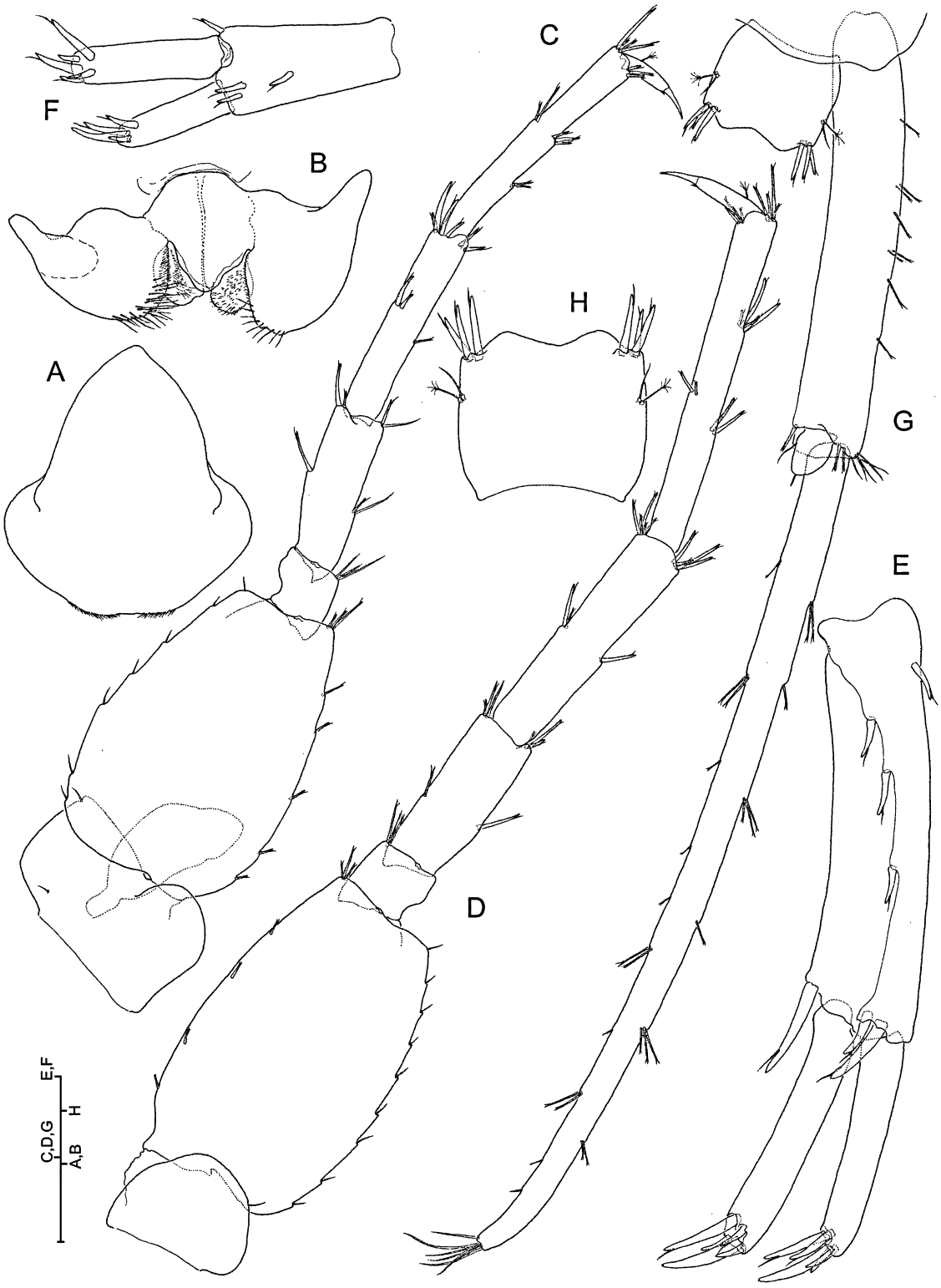

FIGURE 6. *Pseudoniphargus morenoi* **sp. nov.**, male paratype. A, labrum, anterior view; B, paragnaths, anterior (= dorsal); C, left pereiopod 6, lateral; D, right pereiopod 7, lateral; E, right uropod 1, posterolateral; F, right uropod 2, posterior; G, right uropod 3 and telson, posterior (= dorsal); H, detail of telson. [Scale bar: 0.1 mm (A, B); 0.25 mm (C–H)]

Pereiopod 6 (Fig. 6C) basis broad with convex anterior and posterior margins, although more slender than basis of preceding limb (1.5 times as long as broad versus 1.3 times in pereiopod 5); postero-distal angle not produced into overhanging lobe. Dactylus: unguis length ratio as 1.8.

Pereiopod 7 (Fig. 6D) basis more slender than those of pereiopods 5–6, 1.7 times as long as broad, with postero-distal angle not produced into overhanging lobe. Dactylus: unguis length ratio as 2.0.

Epimeral plates I–III (Fig. 1B) with 0–1(2)–2(1) submarginal small robust setae on distal (= ventral) margin; postero-ventral angle of plates not strongly produced; posterior margin broadly convex.

Pleopods with protopod conspicuously constricted subdistally (Fig. 1C), provided with two retinacles partially covered by rounded postermedial outgrowth of segment (Fig. 1D). Rami multi-articulated, proximal article of endopod longer than rest and with proximo-medial seta transformed into robust flagellate element (Fig. 1D).

Uropod 1 (Fig. 6E) protopod with basofacial robust seta and row of 3–4 robust setae along posterolateral ridge; medial margin unarmed; two unequal robust setae on distolateral corner, and longer robust seta on distomedial corner of segment not reaching midway of endopod. Rami devoid of marginal robust setae except in two specimens displaying single robust seta on exopod; each ramus with five unequal robust setae on tip.

Uropod 2 (Fig. 6F) protopod with 1–2 robust setae on posterolateral margin, two robust setae (exceptionally three in one specimen) on distolateral corner and more slender robust seta on distomedial corner. Rami devoid of marginal robust setae, with four (exopod) and five (endopod) robust setae on tip.

Uropod 3 (Fig. 1E) with protopod elongate, up to 6.4 times as long as broad in larger specimens; lateral margin provided with row of slender robust setae; medial margin unarmed. Exopod extremely elongate and upcurved, up to 20.8 times as long as broad in larger males, with marginal clusters of slender robust setae all along, and with cluster of short simple setae on tip. Endopod with reduced simple seta on tip.

Telson (Fig. 6H) slightly (1.1 times) broader than long, with distal margin shallow to markedly excavated (in larger specimens); all specimens with 3+3 robust setae implanted subdistally except three specimens with 4+5, 3+2 and 2+2 robust setae, respectively; tip of lobes unarmed.

Brooding female. Body up to 7.9 mm long. As male except for uropod 3, which is considerably shorter (Fig. 1F, G): Protopod slightly elongate, 2.5 to 2.9 times as long as broad, and exopod 7.8 to 11.2 times as long as broad. Telson comparatively broader (about 1.2 times broader than long; Fig. 1H) than in male; distal excavation varying as in male; all specimens examined with 3+3 robust setae except two specimens displaying 2+2, and one with 4+4 arrangement.

Remarks. Species of *Pseudoniphargus* are described mainly based on a set of very simple morphological features that appear in a species-specific diagnostic combination of states. Irrespective of their taxonomic value, character states shared among species might not be homologous but the result of parallel evolution or state reversal (Notenboom 1988). Out of the 69 species of *Pseudoniphargus* formally described thus far (Jaume *et al*. 2016), three are known only from the female. Out of the remaining 66, only 16 share with the new species from Baena the display of a extremely sexually-dimorphic uropod 3 where the exopod appears strongly elongate in the male (>10 times longer than its maximum width), and where elongation affects also strongly the protopod, which is four or more times as long as broad (see Table 1). Members of this cluster of species can be readily differentiated from each other based on the differential expression of the following features: (1) basofacial robust seta on protopod of uropod 1; (2) dentate dorsal spur on male pleosomite II; (3) posterodistal lobe on basis of male pereiopods 5–7; (4) carpus-to-propodus relative length in male gnathopod 1; (5) outline of propodus of male gnathopod 2 (determined by relative length of posterior margin with respect to palm margin); (5) armature formula of distal margin of epimeral plates; and (6) male uropod 3 length/width ratio of protopod, among other features (see Table 1).

Based on these features, *Pseudoniphargus morenoi* **sp. nov.** is phenetically closest to *P. illustris* Notenboom, 1987, a species known only from the hyporheic habitat of river Guadalbullón—a tributary of the Guadalquivir–, in Jaén (Notenboom 1987a). Nevertheless, the latter species differs in several striking features such as the sharply pointed, produced posterodistal angle of epimeral plates, the more strongly elongate carpus of male gnathopod 1, and the finely denticulate condition of robust setae present on basal endite (= outer lobe) of maxillule.

As previously stated, three species of *Pseudoniphargus* are known only from the female. They are readily differentiated from the female of *P. morenoi* **sp. nov.** as follows: *P. duplus* Messouli, Messana and Yacoubi-Khebiza, 2006, from Sicily, differs in the display of an extremely elongate antennule, as long as body length (compare Messouli, *et al.*, 2006: fig. 1 and our Fig. 1); pereiopod 5 longer than pereiopods 3–4 (versus pereiopod 5 shorter than preceding limbs in *P. morenoi* **sp. nov.**); basis of pereiopods 5–7 with distinct, slightly overhanging postero-distal lobe; protopod of uropod 3 non-elongate (1.7 times as long as broad; versus 2.7 to 2.9 times in the new species); and telson distinctly broader than long (1.9 times as long as broad; versus 1.2 times in the new species), among other features (see Messouli *et al*. 2006).

TABLE 1. Species of *Pseudoniphargus* with male uropod 3 strongly elongate (exopod >10 times as long as broad; protopod ≥ four times longer than broad). G1 and G2 refer to gnathopods 1 and 2, and P5–P7 to pereiopods 5 to 7, respectively.

Species	**Distribution**	♂ **pleosomite II** dentate dorsal spur	**Epimeral plates** armature formula	♂ **G1** carpus/propodus length ratio	♂ **G2 propodus** posterior margin/ palm margin length ratio	♂ **P5-P7** basis, posterodistal lobe	**Uropod 1** basofacial robust seta on protopod	♂ **uropod 3** length/width ratio	
								expopod	**protopod**
P. morenoi **sp. nov.**	S Spain	-	0–(1 or 2)–(1 or 2)	C>P	>1	not developed	+	19.5	7
P. adriaticus S. Karaman, 1955	Mediterranean	+	1–1–1	C=P	>1	narrow and strongly overhanging	+/- (variable among populations)	19.7–23.2	4–6.2
P. affinis Notenboom, 1987	S Spain	-	0–2–2	C=P	<1	not developed	+	24	7.5–9.5
P. africanus Chevreux, 1901	N Algeria	-	0–1–1	C<P	>1	broad and slightly overhanging	+	27.5	9.1–10.3
P. branchiatus Stock, 1980	S Spain	-	0–(1 to 3)–(1 to 3)	?	<1	not developed	+	22	3–4
P. elongatus Stock, 1980	N Spain	-	0–1–1	C=P	>1	broad and slightly overhanging	+	19.8	7.1
P. granadensis Notenboom, 1987	S Spain	-	0–(2 or 3)–(2 or 3)	C>P	=1	not developed	+	18	4–5
P. grandis Notenboom, 1987	S Spain	-	0–(2 or 3)–(2 or 3)	C=P	<1	not developed	+	23	6
P. illustris Notenboom, 1987	S Spain	-	0–1–1	C>>P	>1	not developed	+	22.5	4
P. inconditus Karaman & Ruffo, 1989	Sicily	+	2–4–5	C>P	>1	narrow and strongly overhanging	+	>15	4
P. macrotelsonis Stock, 1980	N Algeria	-	0–(1 or 2)–(1 or 2)	C=P	>1	broad and slightly overhanging	-	>15	6>
P. mercadali Pretus, 1988	Mallorca; Menorca (Balearics)	+	(0 or 1)–(1 or 2)–(2 or 4)	C=P	>1	narrow and strongly overhanging	+	20	3.2–4.6
P. obritus Messouli *et al.*, 2006	Corsica	-	1–2–1	C<P	>1	narrow and strongly overhanging	- (male)/ + (female)	21.8	8.2
P. pedunculatus Sánchez, 1989	Gran Canaria (Canaries)	-	(0 or 1)–(1 or 2)–(1 or 2)	C=P	=1	not developed	-	15.7	7.4
P. sodalis Karaman & Ruffo, 1989	Sicily	-	0–1–2	C<P	=1	not developed	-	20.9	7.1
P. stocki Notenboom, 1987	S Spain	-	0–(1 or 2)–(1 or 2)	C=P	<1	not developed	+	20	6.5
P. vomeratus Notenboom, 1987	S Spain	-	1–1–2	C=P	<1	not developed	+	29	5–5.5

Pseudoniphargus unispinosus Stock, 1988, from Tenerife (Canary Islands) differs, among other features, in the non-elongate protopod of uropod 3 and the distinctly broader-than-long telson (1.9 times as long as broad), which displays a single terminal robust seta on each lobe (Stock 1988).

Finally, *Pseudoniphargus italicus* Karaman & Ruffo, 1989, known also only from the female, differs in the display of robust setae on the lateral margin of rami of uropods 1–2 (versus rami devoid of lateral armature in the new species) and in the comparatively longer distal robust setae of telson (as long as telson itself; versus distinctly shorter in the new species; see Karaman & Ruffo 1989).

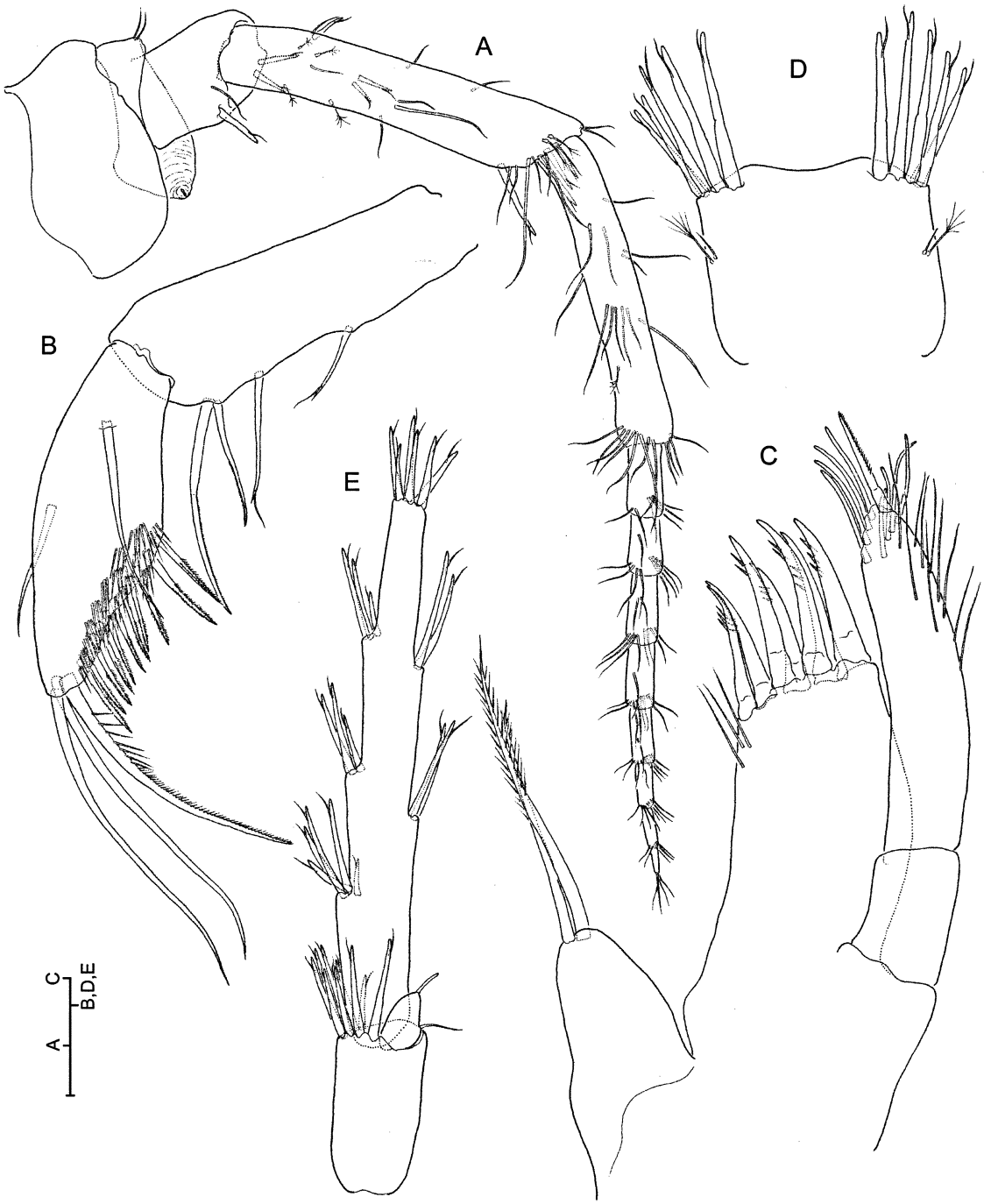

FIGURE 7. *Pseudoniphargus gevi* **sp. nov.**, male paratype 7.9 mm (A–D); female paratype 5.7 mm (E). A, right antenna, lateral; B, distal segments of mandibular palp; C, maxillule; D, telson, dorsal; E, right uropod 3, dorsal. [Scale bar: 0.25 mm (A, D, E); 0.125 mm (B); 0.1 mm (C)]

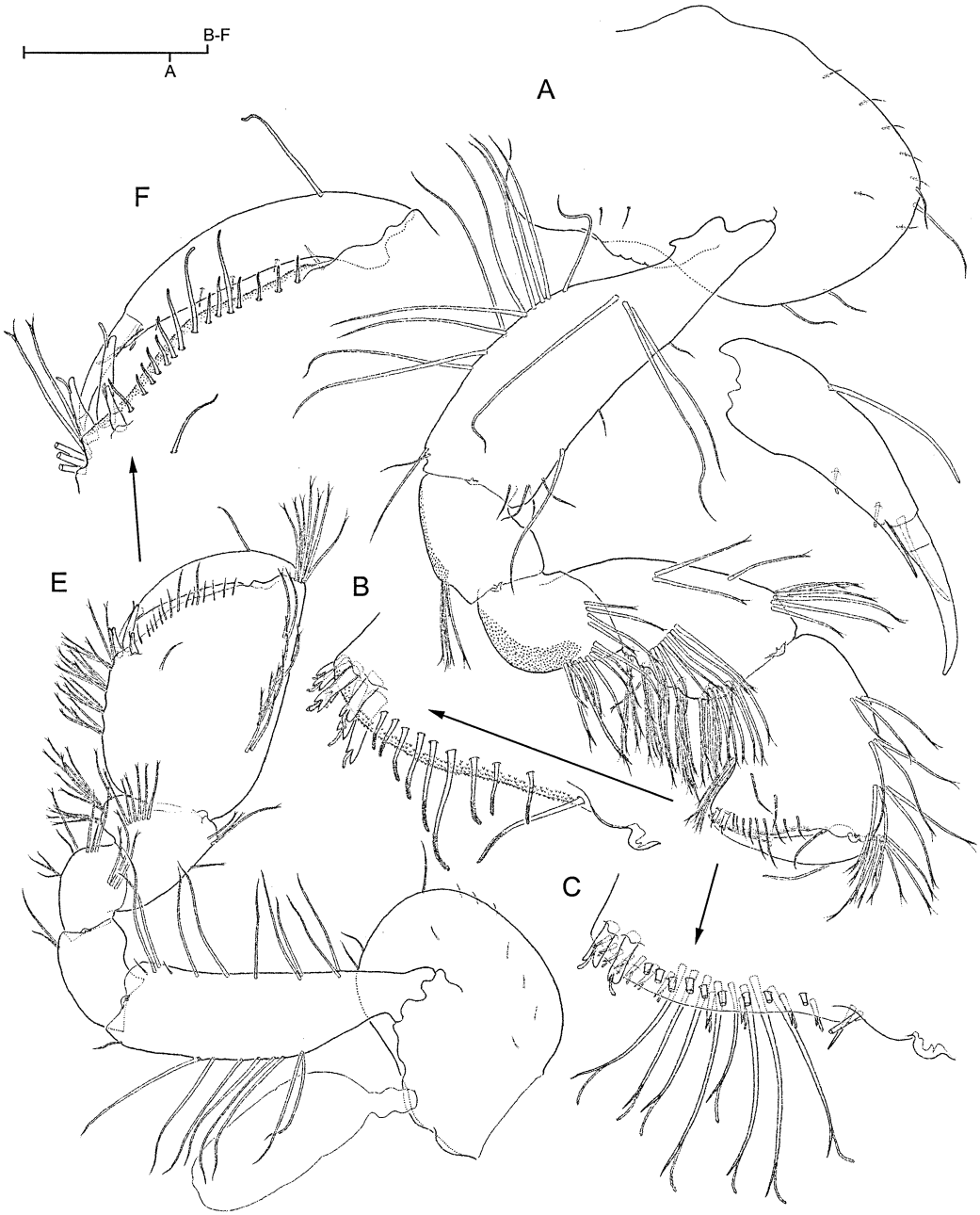

FIGURE 8. *Pseudoniphargus gevi* **sp. nov.**, male paratype 7.9 mm. A, left gnathopod 1, medial; B, detail of palm margin and palm angle, medial (armature on lateral side of margin omitted); C, same, with medial armature omitted; D, nail, medial; E, right gnathopod 2, medial; F, detail of palm margin, palm angle and nail of latter, medial. [Scale bar: 0.25 mm (A); 0.125 mm (B–D, F); 0.5 mm (E)]

Pseudoniphargus gevi **Stokkan & Jaume, sp. nov.**
(Figs 7–10)

Material examined. "Complejo Romeral" (Antequera; Málaga; Spain). UTM coordinates (Datum ED50): 30S 366968; 4100145. HOLOTYPE: male 8.9 mm preserved in single 70 % ethanol vial [**RMNH.CRUS. A.5085**]. PARATYPES: five males between 8.0 and 6.3 mm long, and five females between 6.0 and 5.7 mm, preserved in single 70 % ethanol vial [**RMNH.CRUS. A.5086**]. Collected by Antonio Pérez Fernández, 23 February 2008.

Diagnosis. Male pleosome smooth, lacking dorsal spur on pleosomite II. Epimeral plates each with posterodistal angle evenly rounded, not strongly produced into pointed process. Postero-distal lobe not developed

on basis of male pereiopods 5–7. Male gnathopod 1 carpus longer than corresponding propodus; palm angle with seven bifid robust setae. Uropods 1–2 with only 1–2 marginal robust setae per ramus. Male uropod 3 exopod extremely elongate (up to 22.4 times as long as broad) and upcurved, but with protopod only moderately elongate (3.3 times as long as broad). Female uropod 3 protopod non-elongate (1.8 times as long as broad). Telson slightly broader than long, subquadrate, distal margin with 5+5 robust setae.

Etymology. Species name honouring Grupo de Espeleología de Villacarrillo (G.E.V.), whose members collected the specimens on which the present description is based on.

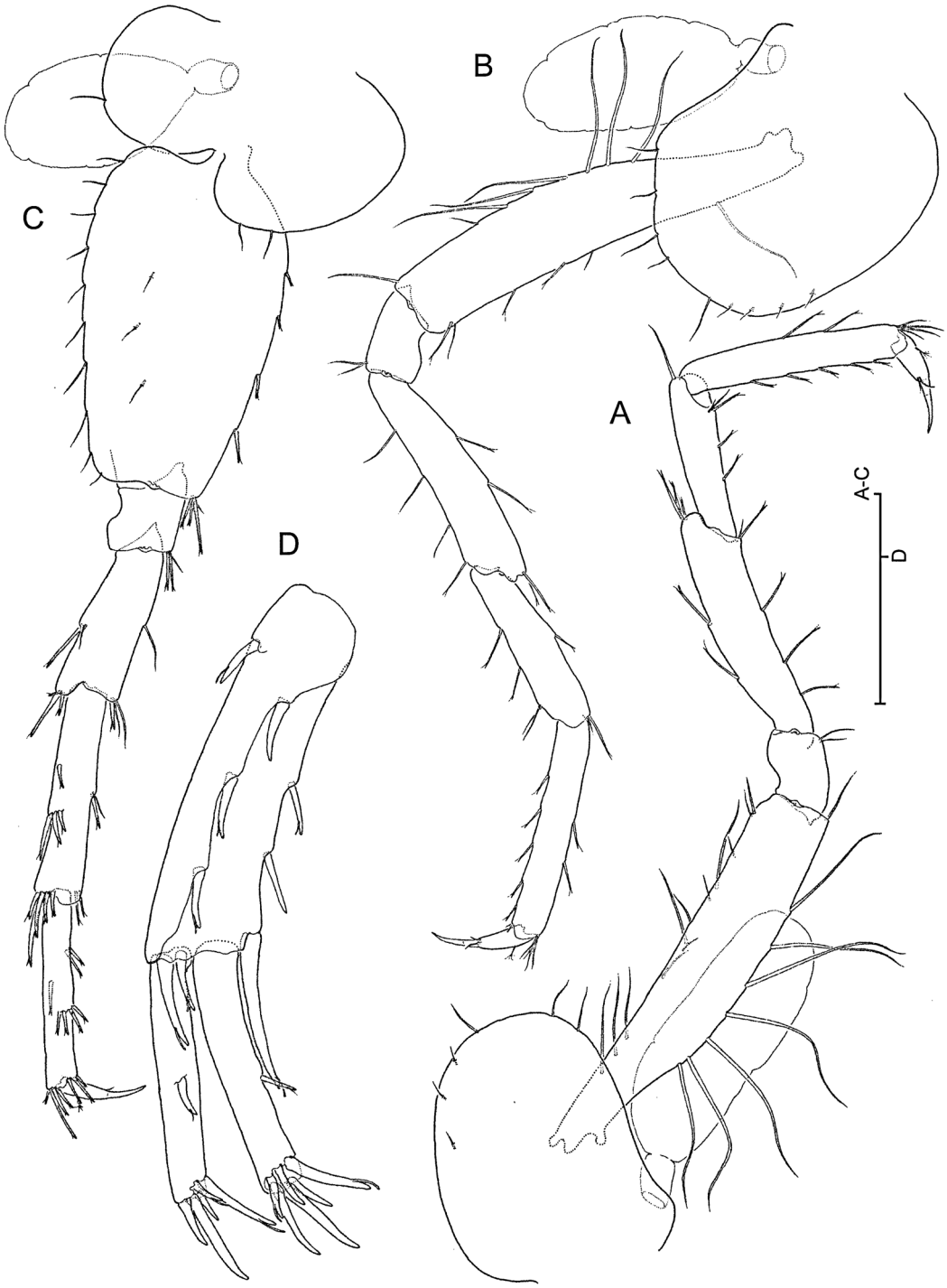

FIGURE 9. *Pseudoniphargus gevi* **sp. nov.**, male paratype 7.9 mm. A, right pereiopod 3, lateral; B, right pereiopod 4, lateral; C, right pereiopod 5, lateral; D, left uropod 1, posterolateral. [Scale bar: 0.5 mm (A–C); 0.25 mm (D)]

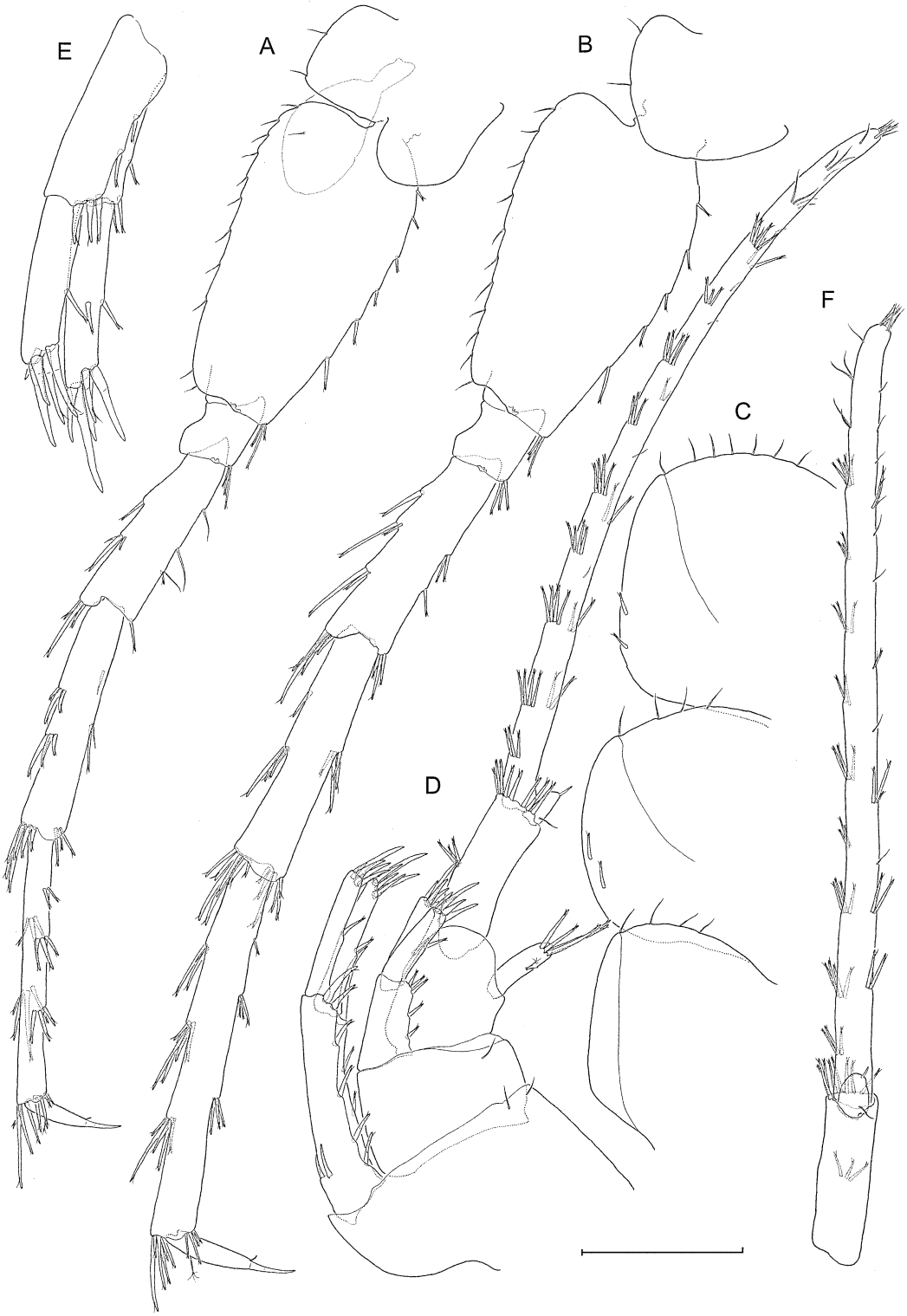

FIGURE 10. *Pseudoniphargus gevi* **sp. nov.**, male paratype 7.9 mm. A, right pereiopod 6, lateral; B, right pereiopod 7, lateral; C, detail of epimeral plates; D, detail of urosome, lateral; E, left uropod 2, lateral; F, left uropod 3, dorsal. [Scale bar: 0.5 mm (A–D, F); 0.25 mm (B)]

Remarks. This species, found in a cave near the town of Antequera (Málaga), conforms with other ten species (see Table 2) a cluster characterised by the display of a strongly sexually dimorphic uropod 3 where the male exopod is strongly elongate (more than 10 times as long as broad) but the protopod is only moderately elongate (2.1 to 3.5 times as long as broad). Species in this group can be differentiated based on: (1) presence/absence of

TABLE 2. Species of *Pseudoniphargus* with male uropod 3 exopod strongly elongate (>10 times as long as broad), but with corresponding protopod only moderately elongate (2.1-3.5 times as long as broad). G1 and G2 refer to gnathopods 1 and 2, and P5-P7 to pereiopods 5 to 7, respectively.

Species	**Distribution**	♂ **pleosomite II** dentate dorsal spur	**Epimeral plates** armature formula	♂ **G1** carpus/propodus length ratio	**G2** palm angle robust setae	♂ **pereiopods 5-7** posterodistal lobe on basis	♂ **uropod 3** length/width ratio		♀ **uropod 3** length/width ratio	
							expopod	**protopod**	**exopod**	**protopod**
P. gevi **sp. nov.**	S Spain	-	0–2–2	C>P	7	not developed	22.4	3.3	7.6	1.8
P. associatus Sánchez, 1991	S Spain	-	(0 or 1)–(1 or 3)–(1 or 2)	C<P	4	not developed	16.2	3.1	6.3	1.6
P. callaicus Notenboom, 1987	NW Spain	-	0–1–2	C<<P	5	broad and overhanging in both sexes	11–12	2.5–3	11–12	2.5–3
P. fragilis Notenboom, 1987	S Spain	-	0–1–2	C<<P	?	narrow to broad, but non-overhanging	16.5	2–2.5	9.6	2.1
P. gibraltaricus Notenboom, 1987	S Spain	-	0–(0 or 1)–(1 or 2)	C>P	?	broad and slightly overhanging	14	2.3–3	14	2.3–3
P. leucatensis Bréhier & Jaume, 2009	S France	-	0–1–1	C<P	6	narrow and strongly overhanging	11.4	3.5	8.8	1.9
P. longicauda Stock, 1988	Tenerife (Canaries)	-	1–(3 or 4)–3	C<P	6	broad and overhanging in both sexes	18–20	2.2	10.3	1.8
P. longipes Coineau & Boutin, 1996	N Morocco	-	1–4–5	?	?	lobe developed and overhanging only on pereiopod V	16	2.2	15.2	2
P. macrurus Stock & Abreu, 1992	Madeira	-	(0 to 2)–(2 or 3)–(1 to 4)	C<P	4	narrow and strongly overhanging	20	2.2	14.5	2.1
P. nevadensis Notenboom, 1987	S Spain	-	0–(1 or 2)–2	C<P	4	not developed	24	3	14	2
P. planasiae Messouli et al., 2006	Pianosa Is. (Tuscan Archipelago)	+	0–4–(3 or 4)	C<P	6	broad and strongly overhanging	13.5	2.6	10	2

posterodistal lobe on basis of male pereiopods 5–7; (2) presence/absence of dentate dorsal spur on male pleosomite II; (3) relative elongation of carpus of male gnathopod 1; (4) number of bifid robust setae on palm angle of gnathopod 1; and (5) armature of epimeral plates (see Table 2). Within this group, the new species is phenetically closest to *P. fragilis* Notenboom, 1987, and *P. nevadensis* Notenboom, 1987, two species of southern Spain that nevertheless differ from the new taxon in the display of a male gnathopod 1 where the carpus is shorter than the propodus (versus carpus longer than propodus in the new species). *Pseudoniphargus nevadensis* is found only in hyporheic habitats of the southern slopes of Sierra Nevada up to 1,420 m a.s.l. (see Notenboom 1987a); it is easily differentiated from the new species based on additional features such as the strongly produced and pointed posterodistal angles of epimeral plates and its longer-than-broad male telson. *Pseudoniphargus fragilis* is known only from wells and hyporheic habitats at Tolox (Granada), and differs from the new species in its much more strongly armoured (robust setae) rami of uropods 1–2 (see Notenboom, 1987a: fig. 34f, g), among other features.

As regard the three species of *Pseudoniphargus* known only from the female (see above), *P. duplus* and *P. unispinosus* differ from the new species in the display of a telson much broader than long and much less armoured. Moreover, *P. duplus* displays a fewer number of bifid robust setae on the palm angle of propodus of gnathopod 1 (4–5; versus seven in the new species). *Pseudoniphargus italicus*, the third species known only from the female, displays a slightly elongate uropod 3 protopod (2.8 times as long as broad; versus only 1.8 times in the female of the new species), aside of displaying also a fewer number of bifid robust setae (4–5) on the palm angle of gnathopod 1.

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