

Stygofauna of the Canary Islands, 9

THE AMPHIPOD GENUS *PSEUDONIPHARGUS* (CRUSTACEA)
IN THE CANARY ISLANDS

by

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ABSTRACT

Pseudoniphargus was known from inland stygohabitats in the Iberian peninsula, the Azores, Madeira, N.W. Africa, and Bermuda, but not from the Canary Islands. Systematic sampling in six of the seven larger islands of the latter archipelago has revealed the presence of the genus in Tenerife (4 species), La Palma (2 species), La Gomera (1 species), and El Hierro (1 species). No *Pseudoniphargus* has been found in Lanzarote and Fuerteventura; Gran Canaria has not been sampled systematically.

RESUMEN

El género *Pseudoniphargus* es conocido de los estigobiotas interiores de la Península Ibérica, Azores, Madeira, N.W. de Africa y Bermuda; sin embargo hasta el momento no había aparecido en las Islas Canarias. El muestreo sistemático en 6 de las 7 islas mayores del archipiélago revela la presencia de este género en Tenerife (4 especies), La Palma (2 especies), La Gomera (1 especie) y El Hierro (1 especie). Por el contrario, *Pseudoniphargus* no ha sido encontrado en Lanzarote ni en Fuerteventura; la isla de Gran Canaria no ha sido muestreada.

1. INTRODUCTION

1.1 BIOGEOGRAPHY

Up to the late nineteen-seventies, the genus *Pseudoniphargus* was believed to comprise a single species only, *Ps. africanus* Chevreux, 1901, but systematic sampling combined with more refined taxonomic observations (Karaman, 1978; Stock, 1980, 1985; Stock et al., 1986; Notenboom, 1986, 1987a, 1987b; and unpublished data) have revealed the existence of 1 marine/anchihaline taxon (in the northern Mediterranean belt), and many inland species:

31 in Iberia (Spain + Portugal), 1 in the Azores, 1 in Madeira, 2 in Algeria, several in the Balearic Islands, and 2 in Bermuda.

Our own fieldwork (1985) in the eastern Canary Islands (the larger islands of Lanzarote and Fuerteventura, and satellites like Alegranza and La Graciosa) failed to demonstrate the presence of *Pseudoniphargus* on these islands, despite their small distance (c. 100 km) from the African continent. Moreover, no representatives of the genus were encountered during an exploration of groundwaters in six islands of the Cape Verde group (Stock, unpublished data, based on sampling during a cruise of R.V. "Plancius", late 1985/early 1986).

These data resulted in a general picture of an old (because amphi-Atlantic) genus *Pseudoniphargus*, restricted to the northern belt of the former Tethys Sea.

Recent systematic sampling executed in the four westernmost islands of the Canary group, viz. in Tenerife, La Gomera, La Palma, and El Hierro, has yielded the surprising discovery of no less than eight different species of *Pseudoniphargus* (not counting some unidentifiable forms). Very recently, a sample accidentally taken in Gran Canaria, in a trickle spring in the sea-cliffs of Playa del Inglés, has yielded one specimen of *Pseudoniphargus* as well. However, since Gran Canaria has not been sampled in a systematic way like the other Canarias, this specimen will not be considered here.

The presence of members of this genus, known from inland and coastal stygohabitats only, in the so-called "oceanic" Canary Islands

convinced me that — to put it very prudently — these islands must have had a prolonged shallow-water phase (possibly as submersed platform resulting from erosion of volcanic cones), and may have had shallow-water contacts with the African plate (Stock, in press a & b).

All described species of *Pseudoniphargus* are very similar to one another, and form no doubt a monophyletic group. The new species described in this paper form no exception. The cause of the proliferation of taxa in the western Canarias remains puzzling. Insular isolation certainly has played a role, since every island has its own species. Moreover, there exists a relationship between island size and the number of taxa per island: the largest island, Tenerife (2058 km²) has 4 species, the second largest, La Palma (730 km²) has 2 species, and the two smallest, La Gomera (383 km²) and El Hierro (278 km²) each have 1 species. The absence of members of the genus in the eastern Canarias is likewise mysterious, the more so since several taxa are known from nearby N.W. Africa.

1.2 SALINITY TOLERANCE AND ISLAND AGE

Some Canarian taxa are recorded from salty waters, several others from fresh groundwaters, but always at low altitudes and never far from the sea. These facts give support to the thought that the genus originated from marine ancestors. However, in the Canarias ecological barriers may also be responsible for the absence of *Pseudoniphargus* (and several other stygobionts) in more inland groundwaters (Stock, in press c).

Some authors have postulated correlations between the distance from the Mid-Atlantic Ridge and island age: the further removed islands lie from the Ridge crest, the older they should be. Data for the Canarias agree with this idea, because from East (Fuerteventura) to West (El Hierro), there is a gradual decrease in age (Abdel-Monem et al., 1971; Grunau et al., 1975; Mitchell-Thomé, 1982). * For the western Canary Islands studied in this paper,

radiometric age determinations (Mitchell-Thomé, 1982) confirm this trend (Tenerife 15.9 ± 1.6 mY; La Gomera 14.6 ± 0.67 mY; El Hierro 3.05 ± 3.0 mY; no data available for La Palma, but thought to be slightly older than El Hierro, and younger than La Gomera).

Our data suggest that *Pseudoniphargus* spp. occur at the lowest salinities in the oldest island (Tenerife), and at the highest salinities in the youngest island (El Hierro). La Gomera and La Palma occupy an intermediate position (table I). Since *Pseudoniphargus* is thought to have evolved from marine ancestors (Stock, 1980), it does strike one as logical that penetration into fresh waters proceeded furthest in the oldest island, and least in the youngest. It must be stressed, however, that our data are based on too low a number of samples to be statistically reliable.

TABLE I

Salinities (in ppt) at which *Pseudoniphargus* spp. are found in the western Canary Islands

Youngest island	El Hierro	<i>salinus</i> spec.	6.3-25.3 2.0	} 2.0-25.3
	La Palma	<i>cupicola</i>	11.9-17.1	
		<i>multidens</i> spec.	1.5 4.2	
Oldest island	La Gomera	<i>gomeræ</i>	1.0-22.0	1.0-22.0
	Tenerife	<i>longicauda</i>	1.1	} 0.3-11.7
		<i>porticola</i>	1.6-3.4	
		<i>unispinosus</i>	0.3	
		<i>fontinalis</i> spec.	0.3 11.7	

Although our knowledge about *Pseudoniphargus* has dramatically increased during the last decade, the overall evolutionary scenario is still multi-interpretable. A number of questions remains to be resolved by future field studies, such as: (1) which species of *Pseudoniphargus* are present on the central island of the Canary group (Gran Canaria)?; (2) is there a prolifera-

* However, when not only the Canarias but also other Atlantic islands are compared, there is no consistency in the ageing of islands away from the Mid-Atlantic Ridge (Schmincke, 1973).

tion of taxa in the Azores archipelago as well?; (3) how is the situation on Madeira?; (4) is the genus entirely absent in the Cape Verde archipelago, more particularly in the geologically oldest, but unexplored, island of Maio?

Notenboom (in a not yet published manuscript) made an impressive effort to deal with most species of *Pseudoniphargus* (with the exception of the North African taxa), using numerical phylogenetic techniques. If and when the gaps in our knowledge, enumerated above, will be filled, it would be worth while to treat the *Pseudoniphargus* species from the mid-Atlantic islands in a similar way, in an attempt to untangle their evolutionary scenario.

2. KEY TO THE CANARIAN SPECIES OF *PSEUDONIPHARGUS*

- 1a) Telson without distal notch; each laterodistal corner of telson with 1 spine only .. *Ps. unispinosus* n. sp. (Tenerife)
- b) Telson with mediodistal notch; each laterodistal corner with 2 or more spines 2
- 2a) Uropod 3 strongly sexually dimorphic (exopodite strongly elongated and more or less upcurved in male) 3
- b) Exopodite of uropod 3 not strongly elongated or upcurved, more or less similar in both sexes 6
- 3a) Medialmost spine of outer lobe of maxilla 1 with 1 or 2 large medial denticles. Carpus of gnathopod 1 very elongate (anterior margin of carpus as long as propodus) *Ps. cupicola* n. sp. (La Palma)
- b) Medialmost spine of outer lobe of maxilla 1 with 3 to 5 small medial denticles. Carpus less elongate (anterior margin of carpus shorter than propodus) 4
- 4a) Propodus of gnathopods 1 and 2 wide; posterior emargination of coxal plate 4 short and rather deep. *Ps. porticola* n. sp. (Tenerife)
- b) Propodus of gnathopods 1 and 2 not widened; posterior emargination of coxal plate 4 long and shallow 5
- 5a) Ventral margin of epimeral plates 2 and 3 with 4 or 5 spines; posterior margin of carpus of gnathopod 1 with 5 groups of setae *Ps. multidentis* n. sp. (La Palma)
- b) Ventral margin of epimeral plates 2 and 3 usually with 3 spines only; posterior margin of carpus of gnathopod 1 with 3 groups of setae *Ps. longicauda* n. sp. (Tenerife)
- 6a) Distal telson notch wide and shallow. Uropod 3, exopodite short (6-7 times as long as wide); lateral and medial margins with 2-3 groups of spines *Ps. fontinalis* n. sp. (Tenerife)
- b) Distal telson notch narrow and rather deep. Uropod 3, exopodite rather long (more than 8 times as long as wide); lateral and medial margins with 3-5 groups of spines 7
- 7a) Telson not much wider than long. Antenna 1 not very slender. Posterior margin of carpus of gnathopod 1 with 5 groups of setae *Ps. gomerae* n. sp. (La Gomera)
- b) Telson much wider than long. Antenna 1 very slender. Posterior margin of carpus of gnathopod 1 with 3 groups of setae *Ps. salinus* n. sp. (El Hierro)

3. DESCRIPTION OF THE CANARIAN SPECIES

All illustrations in this paper have been made from the type specimens. All samples have been deposited in the Zoölogisch Museum Amsterdam (ZMA).

3.1 SPECIES FROM TENERIFE

Pseudoniphargus porticola n. sp. (Figs. 1-4)

Material. — One ♂ (holotype), one ovigerous ♀ (allotype), thirty-three paratypes. Tenerife, Sta. 86-506, Playa del Arenal, just E. of Bajamar; "galería" (= horizontal shaft dug for water supply) feeding a pumped well, locally known as Pozo del Loco; UTM coordinates CS 36925 × 315950; completely dark; slowly running water; bottom loam, stones, gravel, wood debris; the well is just above the storm-tide level and the galería runs inside a volcanic cliff, some 20 m from the steep cliff slope; sampled at various dates: 26 Oct. 1986 (water temperature 20.6°C, conductivity 2.59 mS/cm); 31 Oct. 1986; 23 Nov. 1986 (temp. 19.7°C, conductivity 5.67 mS/cm, oxygen saturation 99%). The conductivities registered correspond with salinities of approximately 1.6-3.4 ppt. (Coll. no. ZMA Amph. 108.370.)

Accompanying fauna. — Amphipoda (*Rhipidogammarus*), Nematoda, Oligochaeta.

Description. — Strongly resembling *Ps. brevipedunculatus* Stock, 1980, from Faial (Azores), abbreviated *P.b.* in the sequel. Body (fig. 1), length (without uropods) of adults of



Fig. 1. *Pseudoniphargus porticola* n. sp., ♂ holotype, from the left.

both sexes 5-6 mm. Colour pale ivory, intestine brown, no eyes. Ovigerous females with 4 to 7 eggs, egg size c. 0.29×0.41 mm.

Antenna 1 about half as long as body; morphology similar to that of *P. b.*

Antenna 2 much shorter than first, as in *P. b.*

Mandible palp (fig. 2a): segment 2 with about 6 ventral setae; segment 3 with 1 A-seta, 2 B-setae, c. 10 D-setae (decreasing in length in distal direction), and 4 E-setae.

Outer lobe of maxilla 1 with 7 spines (fig. 2b), ornamented (from lateral to medial) with 1, 1, 1, 1, 2, 1 (or 2), and 4 to 5 medial teeth, respectively.

Inner lobe of maxilliped (fig. 2c) with 4 distal spines, 2+2 distal setae, and 2 subdistal setae.

Gnathopod 1 (fig. 2d): Coxal plate slightly longer than wide, with 6 anteroventral and 4 posteroventral setules. Basis with 1-3 short anterior setae and 7-11 posterior setae. Carpus and propodus without sexual dimorphism; carpus with 2 rows of setae on medial surface

and 4 groups of setae (+ 1 distal group) on posterior margin; propodus rather wide (almost 1.5 times as long as wide), with 3-4 groups of setae on posterior margin and 6 bicuspidate palmar angle spines; the two cusps of these spines are equally long; palmar margin with 10-12 small bifid spines.

Gnathopod 2 (fig. 2e): Ventral margin of coxal plate with several (c. 6) ventral setules. Basis with 7-9 anterior setae and 6-10 posterior setae. Carpus not sexually dimorphic. Propodus of male (holotype) 810×627 μm , larger than but of similar shape as in female (allotype: 574×397 μm); posterior margin of propodus with 4 groups of setae; 3 palmar angle spines, largest spine less than twice as long as next largest.

Coxal gills on gnathopod 2 and pereopods 3 through 6, stalked; gill of gnathopod 2 about $2/3$ as long as basis. Oostegites (fig. 3a) on gnathopod 2 and pereopods 3 through 5, linear.



Fig. 2. *Pseudoniphargus porticola* n. sp.: a, mandible palp, ♂ (scale 1); b, distal spines of outer lobe of maxilla 1, ♀ (2); c, inner lobe of maxilliped, ♂ (3); d, gnathopod 1, ♂ (4); e, gnathopod 2, ♂ (5); f, coxal plate 3, ♂ (5). Scales on fig. 4.

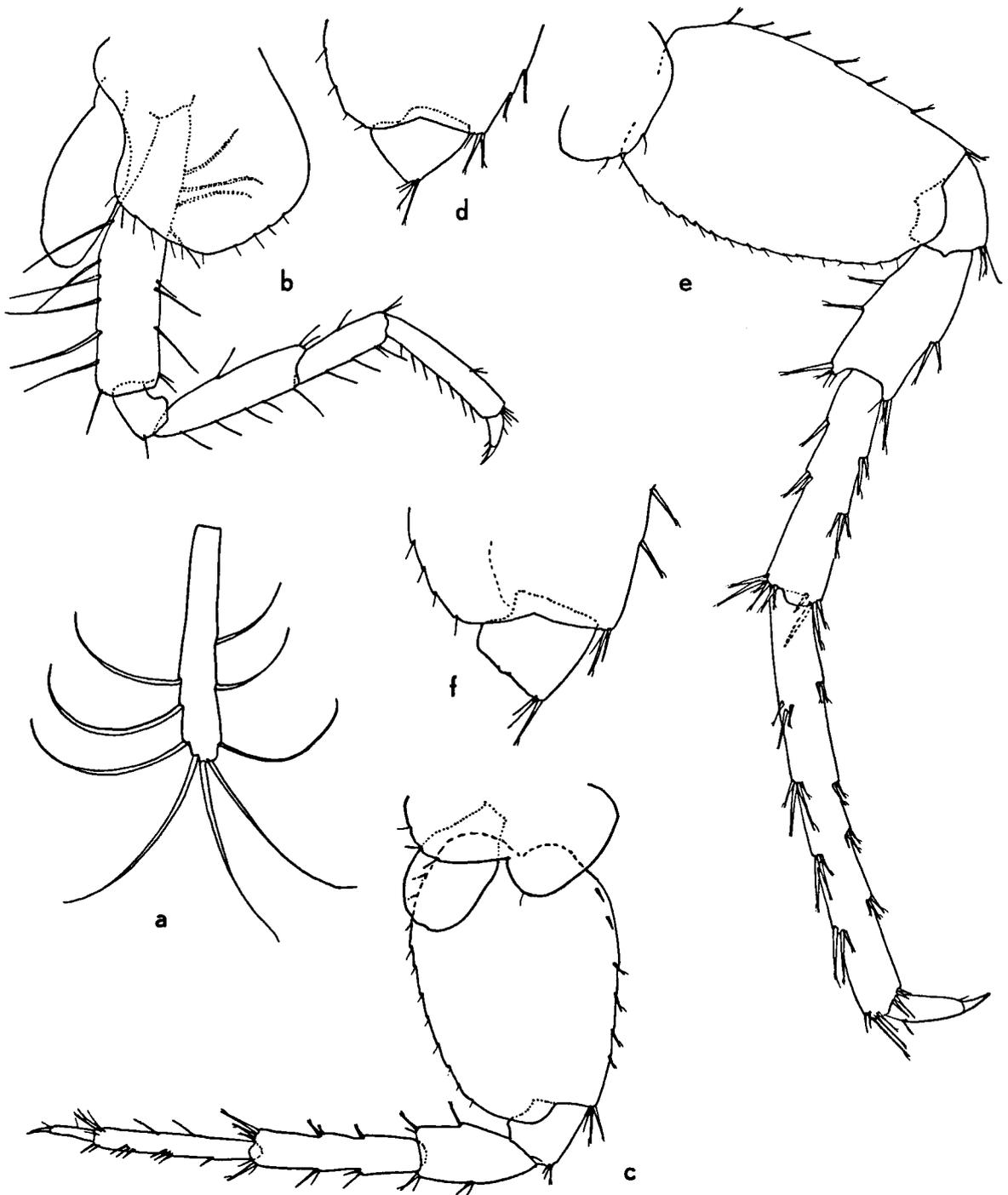


Fig. 3. *Pseudoniphargus porticola* n. sp.: a, oostegite of perieopod 3, ♀ (scale 5); b, perieopod 4, ♂ (5); c, perieopod 5, ♂ (5); d, basis of perieopod 5, ♀ (5); e, perieopod 7, ♂ (5); f, basis of perieopod 7, ♀ (4). Scales on fig. 4.

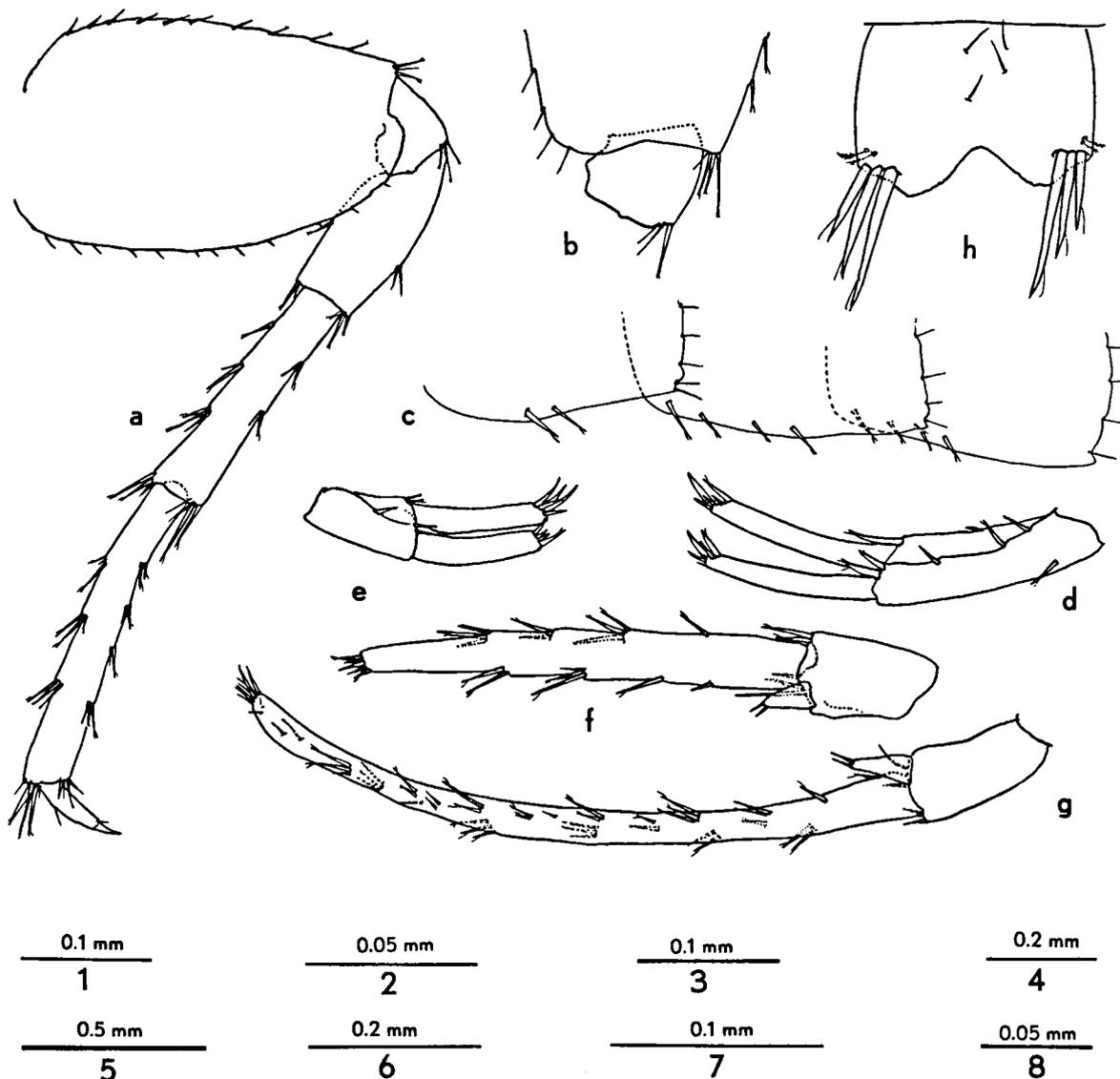


Fig. 4. *Pseudoniphargus porticola* n. sp.: a, pereopod 6, ♂ (scale 5); b, basis of pereopod 6, ♀ (4); c, epimeral plates 1-3, ♀ (5); d, uropod 1, ♂ (5); e, uropod 2, ♂ (5); f, uropod 3, ♀ (5); g, uropod 3, ♂ (5); h, telson, ♂ (6).

Coxal plate 3 narrow, with c. 6 ventral setules (fig. 2f); coxal plate 4 wider, with rather short but rather deep posterior emargination, ventral margin with c. 5 setules, posterodistal margin with c. 6 setules (fig. 3b); remaining segments of P3 and P4 similar.

Basis of pereopods 5 to 7 with wide posteroventral lobe; lobe of male slightly deeper than that of female (figs. 3c-f, 4a-b). Posterior margin of basis of P5 and P7 convex, of P6

straighter; number of setules on posterior margin c. 12 (P5), 12 (P6), or 15 (P7). P5 ≪ P6; basal five segments of P6 in female as long as in male, but propodus much shorter.

Epimeral plates 1 to 3 (fig. 4c) with almost straight ventral margin; posterior margin almost straight in plates 1 and 2, slightly convex in plate 3, armed with several setules. Ventral margin with 2 (plate 1) to 4 (plates 2 and 3) spines.

Uropod 1 (fig. 4d) with proximoventral peduncular spine; dorsolateral peduncular margin with 2-4 spines, dorsomedial margin with 1 spinule; distal end of peduncle with 2 + 1 spines. Rami with distal spines only.

Uropod 2 (fig. 4e): peduncle with 1 dorsal spine and 2 + 2 distal spines; rami with distal spines only.

Uropod 3 with strong sexual dimorphism in exopodite. Peduncle without any tendency towards elongation. Endopodite short, scale-like, with 2 distal spinules. Exopodite of female slightly tapering, 8-8.5 times as long as wide, with long lateral and medial spines; distal spines short (fig. 4f). Exopodite of male strongly elongated, 15-16 times as long as wide, half as long as body, upcurved, with many groups of irregularly implanted long spines (fig. 4g).

Telson (fig. 4h) not sexually dimorphic, wider than long, with subdistal group of 3 (rarely 2) spines; longest spine almost as long as telson; produced into rounded, unarmed mediodistal lobe; medial emargination wide, V-shaped, deepest point reaching to a level below the implantation of the subdistal spines; 2 sensorial setules on either side, inserted near implantation of subdistal spines.

Etymology. — From the Latin words *porticus* (= gallery) and *incola* (= inhabitant), alluding to the habitat of this species in a "galería" (shaft for water production in the Canary Islands).

Remarks. — The strongly elongated and upcurved exopodite, in combination with a non-elongated peduncle, of the male uropod 3, as well as the wide posteroventral lobes of pereopods 5 to 7, relate the new species with *Ps. brevipedunculatus* Stock, 1980, from Faial (Azores). I have rechecked the types of *brevipedunculatus*, and observed the following differences: (1) basis of gnathopod 1 bearing about twice as many posterior setae in *porticola*; (2) posterior margin of propodus with 3-4 groups of setae (2 in *brevipedunculatus*); (3) propodus of gnathopod 2 wider, and palma longer, in *porticola*; (4) basis of gnathopod 2 more richly setose in *porticola*; (5) longest palmar angle spine

of gnathopod 2 less than twice as long as second-longest in *porticola* ($\geq 2 \times$ in *brevipedunculatus*); (6) *brevipedunculatus* has a slightly higher number of setules on the posterior margin of the basis of pereopods 5 to 7, and these setules are implanted at shorter distances of one another; (7) the basis of pereopod 6 is more strongly convex in *brevipedunculatus*; (8) the coxal gills of pereopods 3 and 4 reach to about the middle of the basis in *porticola*, to over 2/3 in *brevipedunculatus*; (9) the epimeral plates tend to have more ventral spines and more posterior setules in *porticola*; (10) the telson has 3 subdistal spines in *porticola* (2 in *brevipedunculatus*) and a slightly wider distal emargination in *porticola*.

***Pseudoniphargus longicauda* n. sp.**
(Figs. 5-6)

Material. — One ♂ (holotype), one ovigerous ♀ (allotype), ten paratypes. Tenerife, sta. 87-32, Pozo Playa de San Marcos; UTM coordinates CS 33130 × 314005; a c. 5 m deep well connected with a galería of some 100 m in length; the well itself is dry, but water is found in the (semi)obscurity of the galería; bottom loam, wood debris; temperature 18.4°C; conductivity 1914 μ S/cm (salinity c. 1.1 ppt); the atmosphere in the galería is barely suitable for human breathing, due to a high carbon dioxide content; 24 Apr. 1987 (ZMA Amph. 108.371).

Accompanying fauna. — Collembola, Harpacticoida.

Description. — Body length (both sexes) 5-6.5 mm. Ovigerous females with up to 10 eggs. Colour whitish, no eyes. Very similar to *Ps. porticola* (abbreviated *P.p.*), described above.

Antennae, mandible, second maxilla and maxilliped as in *P.p.* Outer lobe of maxilla 1 with 7 spines, ornamented (from lateral to medial) with 2, 2, 2, 2, 1, 0, and 1 teeth, respectively.

Gnathopod 1 (fig. 5a): Posterior margin of basis with 4-8 long setae. Propodus distinctly narrower than in *P.p.*; posterior margin with 2 groups of setae; 6 bicuspidate palmar angle spines, cusps of these spines of equal length.

Gnathopod 2 (fig. 5b): Basis with fewer long setae than in *P.p.* Propodus distinctly narrower than in *P.p.*; palmar margin shorter, posterior margin longer; posterior margin with 2-3 groups of setae.

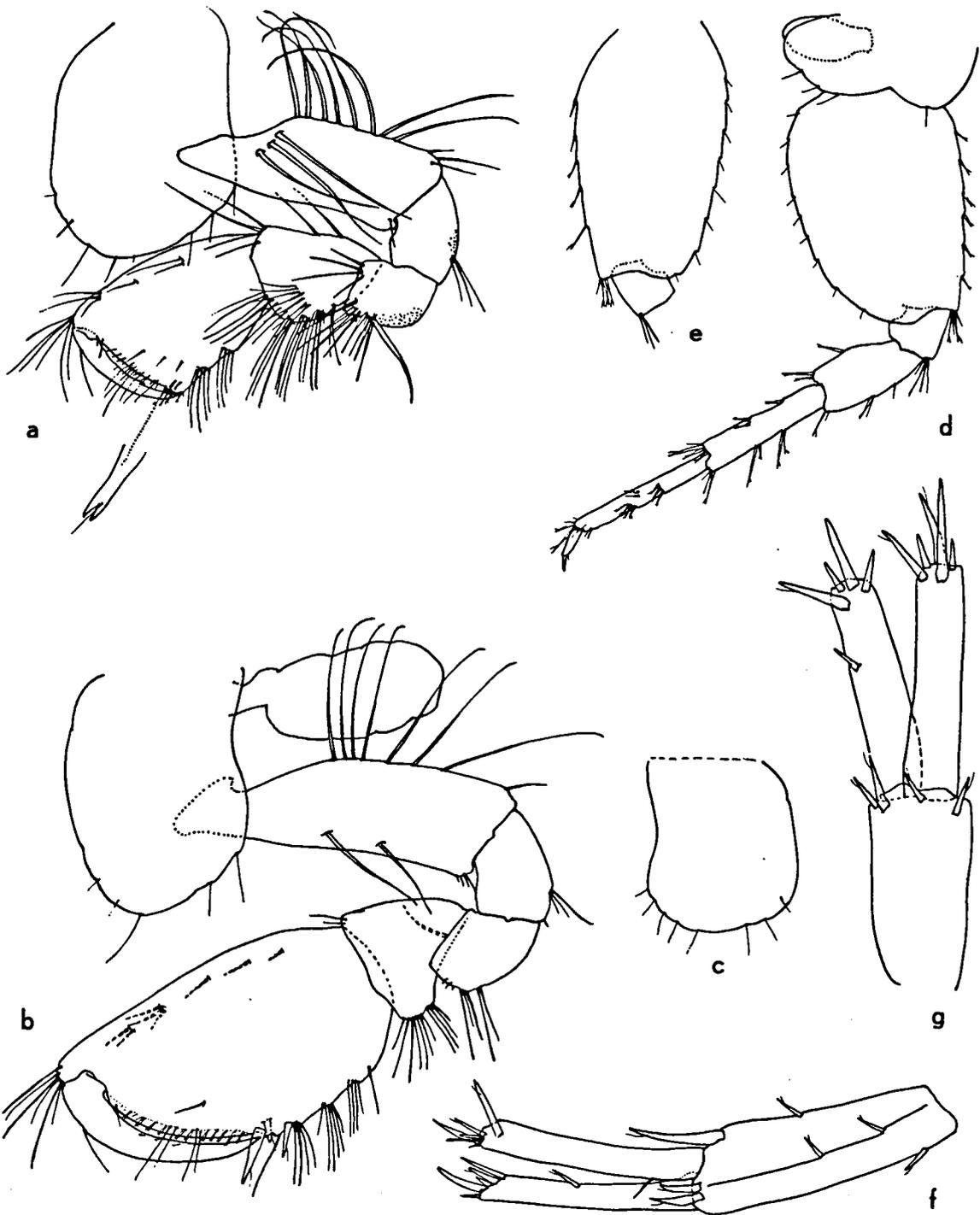


Fig. 5. *Pseudoniphargus longicauda* n. sp.: a, gnathopod 1, ♂ (scale 4); b, gnathopod 2, ♂ (4); c, coxal plate 4, ♂ (5); d, pereopod 5, ♂ (5); e, basis of pereopod 5, ♀ (5); f, uropod 1, ♂ (4); g, uropod 2, ♂ (6). Scales on fig. 4.

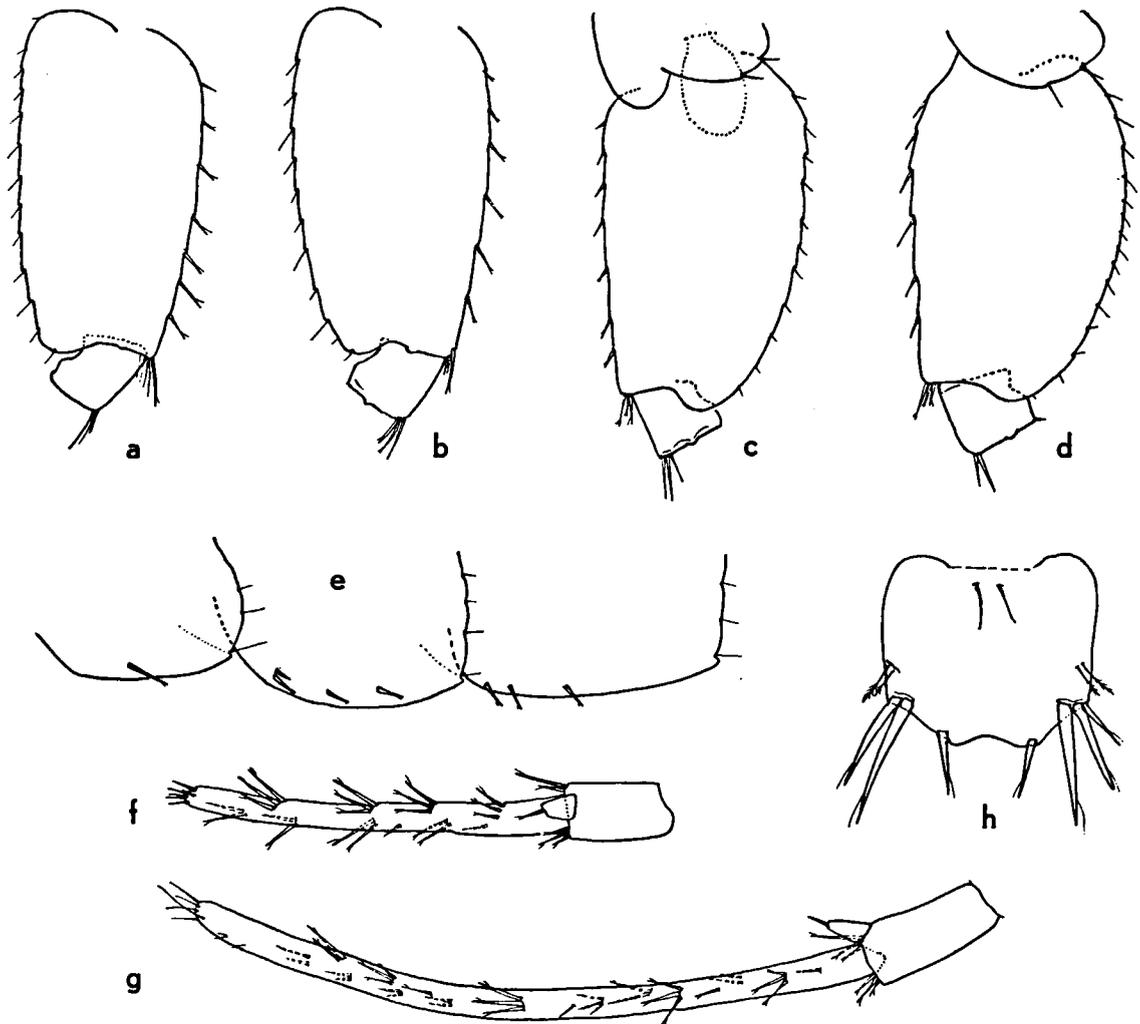


Fig. 6. *Pseudoniphargus longicauda* n. sp.: a, basis of pereopod 6, ♀ (scale 5); b, basis of pereopod 7, ♀ (5); c, basis of pereopod 6, ♂ (5); d, basis of pereopod 7, ♂ (5); e, epimeral plates 1-3, ♂ (5); f, uropod 3, ♀ (5); g, uropod 3, ♂ (5); h, telson, ♂ (6). Scales on fig. 4.

Coxal plate 4 (fig. 5c) with fewer setules, and posterior emargination shallower but longer than in *P.p.*

Pereopods 5-7 (figs. 5d-e, 6a-d) with slight sexual dimorphism in shape of basis: posterior margin of female straighter, that of male more convex; posteroventral lobe of male slightly deeper than in female. P5-P7 otherwise resembling those of *P.p.*

Epimeral plates 1-3 (fig. 6e) with 1, 3 to 4, and 3 ventral spines, respectively.

Uropod 1 (fig. 5f): Mediodistal spine of

peduncle very long. Exopodite sometimes with 1 dorsal spine, usually unarmed.

Uropod 2 (fig. 5g): Exopodite sometimes with 1 dorsal spine.

Uropod 3 (figs. 6f-g): Exopodite in male strongly elongate (18-20 times as long as basal diameter), upcurved (as in *P.p.*); in female less elongate, 9-10 times as long as wide, slightly upcurved.

Telson (fig. 6h): Hardly wider than long; 2 or 3 latero-subdistal spines; 1 shorter mediodistal spine; distal emargination very

shallow, not reaching level of implantation of subdistal spines.

Etymology. — The specific name proposed, *longicauda*, alludes to the long uropods (in female, but in particular in male).

Remarks. — This species is closely related to *Ps. porticola*, likewise from Tenerife, in the combination of a strongly elongate exopodite of the male uropod 3 and a short peduncle.

It differs markedly from *Ps. porticola* in the shape and armature of the telson, and in the less widened propodus of gnathopods 1 and 2. Other, smaller, differences have been indicated in the above description.

***Pseudoniphargus fontinalis* n. sp.**
(Figs. 7-9)

Material. — One ♀ with setose oostegites (holotype), one ♂ (allotype), fourteen paratypes. Tenerife, sta. 86-514, Playa de las Aguas (E. of Garachico); UTM coordinates CS 32895 × 313965; small spring just above storm-tide level; clean; slowly running; washed from gravel and stones; temperature 21.0°C; conductivity 408 μS/cm (salinity c. 0.3 ppt); 2 Nov. 1986 (ZMA Amph. 108.372). Accompanying fauna. — Isopoda (*Jaera*), Gastropoda (*Physa*), Planaria, and *Pseudoniphargus unispinosus*.

Description. — A small species (adult females with setiferous oostegites, but not ovigerous, 3.7-4.0 mm; male 3.5 mm). Colour white; blind.

Antenna 1 (fig. 7a) rather slender, not very setose, slightly less than half as long as the body; flagellum 14-segmented; aesthetascs on segments 5 to 13, length $\frac{1}{2}$ to $\frac{2}{3}$ of corresponding flagellum segment.

Antenna 2 (fig. 7b), somewhat more than half as long as antenna 1, with few but rather long setae; flagellum 7-segmented.

Mandible palp (fig. 8a): Segment 2 with 5 setae on ventral margin. Segment 3 with 2 A-setae, 2 B-setae (implanted on dorsal margin), 9 D-setae (proximal ones slightly longer than distal ones), and 4 E-setae.

Outer lobe of maxilla 1 with 7 distal spines, ornamented (from lateral to medial) with 1, 3, 1, 2, 2, 1, and 4 teeth, respectively.

Inner lobe of maxilliped with 2 distal spines and 4 distal setae.

Gnathopod 1 (fig. 7c): Coxal plate longer than wide, with 4-5 setules on ventral margin. Basis with 0-1 setae on anterior margin, 8-12 long setae on posterior margin, and tuft of 2-3 long setae on medial surface. Carpus with 3 groups of setae on posterior margin, not sexually dimorphic. Propodus short, distally slightly dilated; posterior margin with 2 groups of setae; 4 bicuspidate palmar angle spines (cusps equally long).

Gnathopod 2 (fig. 7d): Coxal plate with 3 setules on ventral margin; coxal gill stalked, longer than half the basis. Basis with 3-5 long setae on anterior margin, 6-8 on posterior margin. Carpus not sexually dimorphic. Free posterior margin of propodus shorter than palmar margin, with 4 groups of setae; 3 palmar angle spines (longest about 1.5 times as long as second-longest); claw very slender.

Pereiopod 3: Coxal plate with 2 setae on ventral margin (fig. 8b). Remaining part of leg as P4.

Pereiopod 4 (fig. 8c): Coxal plate with 4 setae on ventral margin; posterior emargination shallow. Posterior margin of basis with many (8-10) long setae. Coxal gill $\frac{3}{4}$ of length of basis.

Pereiopod 5 (fig. 8d) much shorter than P6. Basis with wide but hardly overhanging posterodistal lobe; no sexual difference in shape of lobe (fig. 8e). Posterior margin of basis with 6-7 short setules.

Pereiopod 6 (fig. 8f) as long as P7 (figs. 9a-b); no sexual differences; basis with 7-9 setules on posterior margin.

Epimeral plates (fig. 9c) with regularly curved posterior margin, armed with 2 or 3 setules. Posterodistal corner with small tooth. Ventral margin with 1, 3, and 2 spines, respectively.

Uropod 1 (fig. 8g): Peduncle with small proximoventral spine, short mediodistal spine, 2 laterodistal spines, and 2 + 1 dorsal spines. Rami sometimes with, sometimes without a middorsal spine; middorsal spine more common on endopodite than on exopodite.

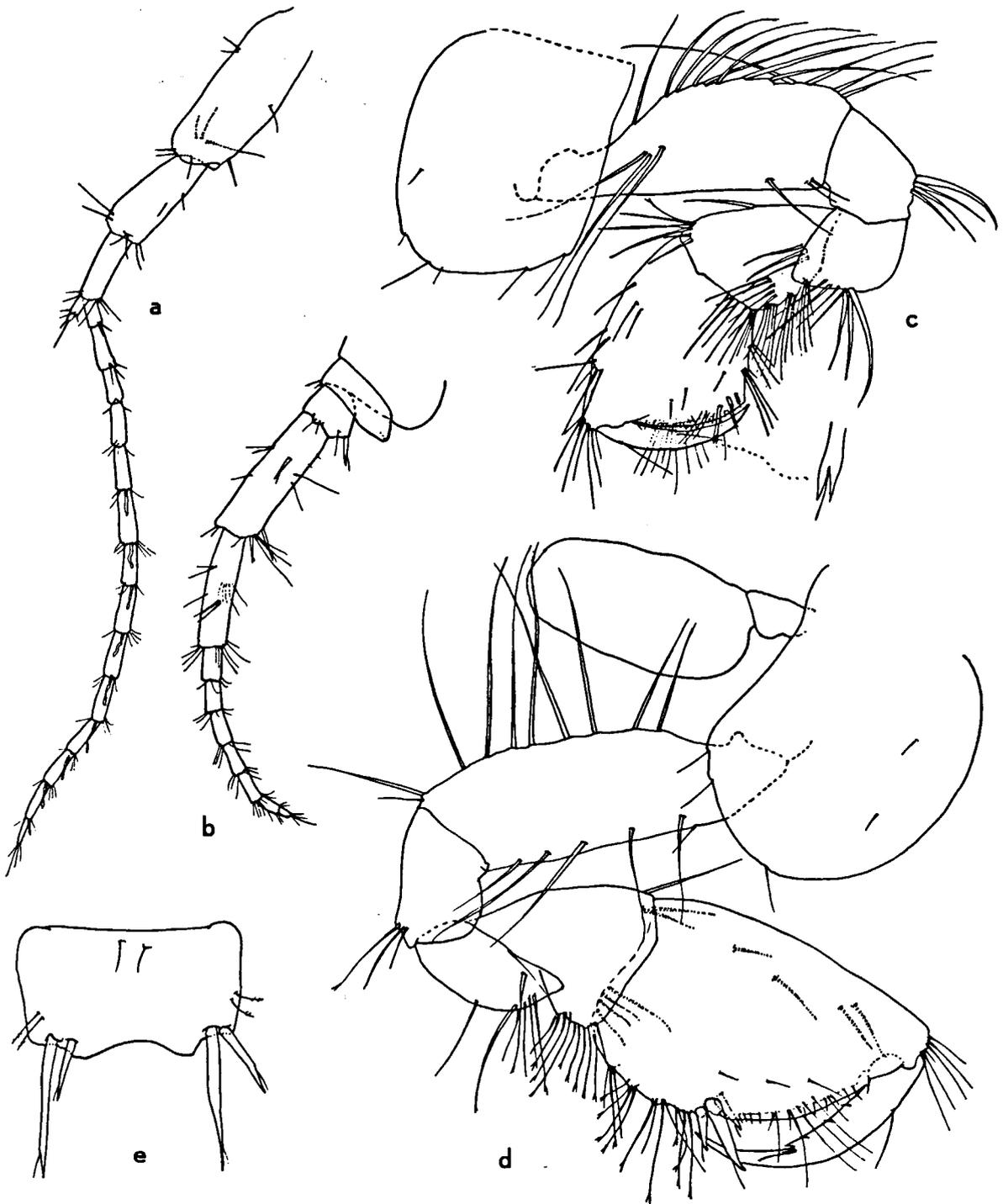


Fig. 7. *Pseudoniphargus fontinalis* n. sp.: a, antenna 1, ♀ (scale 4); b, antenna 2, ♀ (4); c, gnathopod 1, ♀ (6); d, gnathopod 2, ♀ (6); e, telson, ♀ (1). Scales on fig. 4.

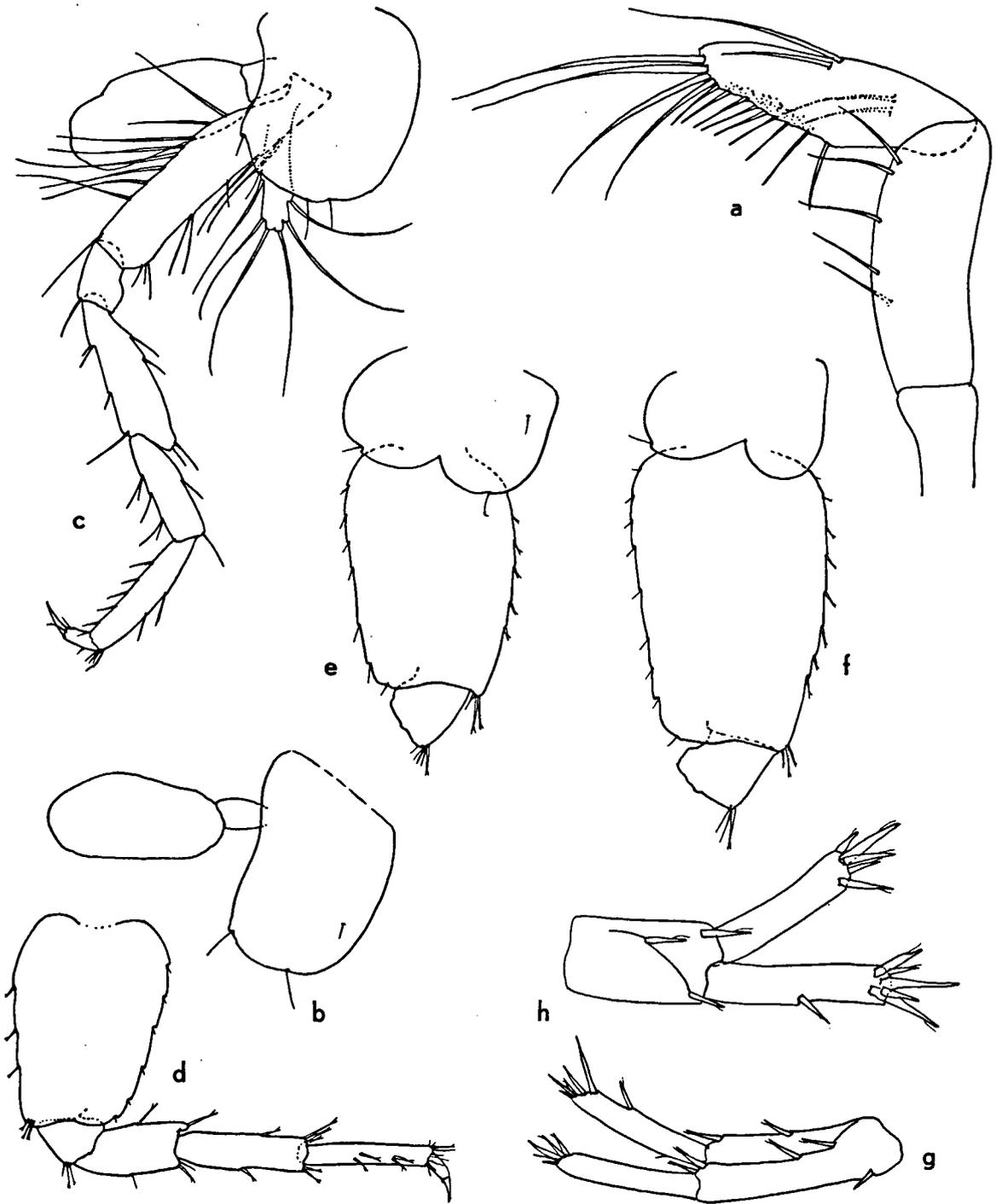


Fig. 8. *Pseudoniphargus fontinalis* n. sp.: a, mandible palp, ♀ (scale 7); b, coxal plate 3 and gill, ♀ (4); c, pereiopod 4, ♀ (4); d, pereiopod 5, ♂ (4); e, basal part of pereiopod 5, ♀ (4); f, basal part of pereiopod 6, ♀ (4); g, uropod 1, ♀ (4); h, uropod 2, ♀ (6). Scales on fig. 4.

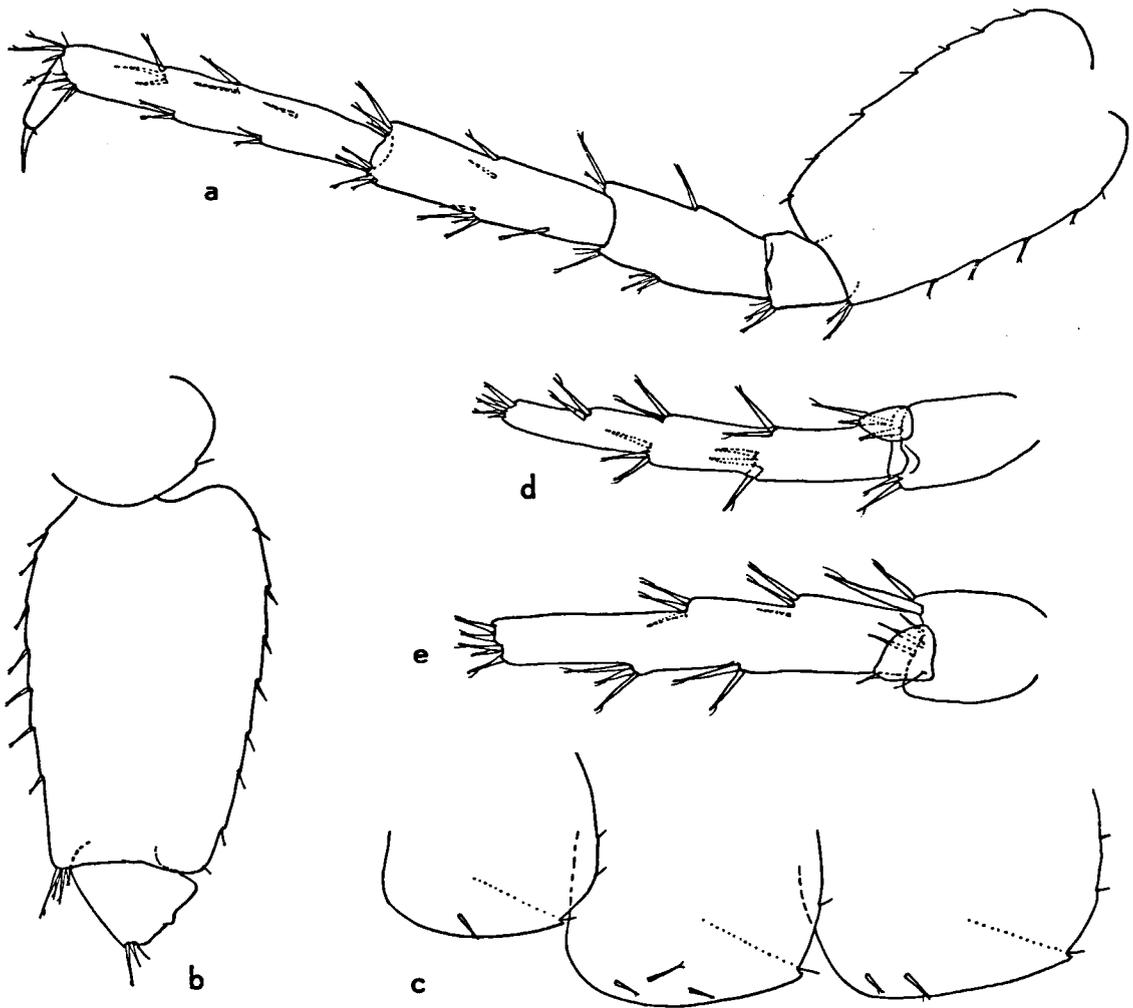


Fig. 9. *Pseudoniphargus fontinalis* n. sp.: a, pereiopod 7, ♂ (scale 4); b, basal part of pereiopod 7, ♀ (4); c, epimeral plates 1-3, ♀ (4); d, uropod 3, ♂ (6); e, uropod 3, ♀ (6). Scales on fig. 4.

Uropod 2 (fig. 8h): Peduncle with 1 dorsal spine and 1 + 1 distal spines. Endopodite sometimes with middorsal spine.

Uropod 3 (figs. 9d-e): Short in both sexes, with 2 or 3 groups of marginal spines on exopodite; distal spines short.

Telson (fig. 7e): Slightly less than twice as wide as long, with 1 long and 1 short spine in latero-subdistal position; mediad of these spines, a distinct, naked lobe occurs; medio-distal emargination wide, shallow, regularly rounded. No sexual differences.

Etymology. — The specific name *fontinalis*

(Latin, living in springs) refers to the habitat of the animal.

Remarks. — In Notenboom's (1987b) key to the Iberian species of *Pseudoniphargus*, this species can be followed down to couplet 20, where it falls in 20a for the telson, but in 20b for the third uropod; also for the other characters used in couplet 20, the present species is intermediate. Judging from the telson shape, the Canary taxon may be related to *Ps. mateusorum* Stock, 1980 (see also Notenboom, 1987b: 197) from Portugal, but this species has sexually dimorphic third uropods and

pereiopods 5-7, differently ornamented spines on the outer lobe of maxilla 2, longer aesthetascs, and a more slender propodus in gnathopod 2. Likewise, *Ps. montanus* Notenboom, 1986, from N.W. continental Spain, resembles the new species somewhat, but has more numerous spines on the telson and on uropods 1 and 2, and a more deeply emarginate posterior margin of coxal plate 4.

***Pseudoniphargus unispinosus* n. sp.**

(Fig. 10)

Material. — One ♀ (holotype). Tenerife, sta. 86-514, Playa de las Aguas (E. of Garachico); UTM coordinates CS 32895 × 313965; small spring just above storm tide level; clean; slowly running; washed from gravel and stones; temperature 21.0°C; conductivity 408 µS/cm (salinity c. 0.3 ppt); 2 Nov. 1986 (ZMA Amph. 108.373). Accompanying fauna. — See under *Ps. fontinalis*.

Description. — Holotype non-ovigerous, but with setose oostegites; body length 4.2 mm; blind, colourless. Very similar to *Ps. fontinalis*, described above from the same locality. It suffices to describe the points of agreement with, and the differences from *fontinalis* (abbreviated *f*).

Antenna 1 similar to *f*; flagellum 14-segmented; aesthetascs about half as long as corresponding flagellum segment. Antenna 2 similar to *f*; flagellum 7-segmented.

Mandible palp (fig. 10a) with fewer setae than *f* on segment 2; segment 3 with 1 A-seta, 2 B-setae (implanted on dorsal margin), 11 D-setae, and 3 E-setae.

Spines of outer lobe of maxilla 1 with 0, 1, or 2 denticles; inner lobe with 2 setae.

Inner lobe of maxilliped with 2 subterminal spines, 2 terminal spines, and 4 terminal setae.

Gnathopod 1 resembling that of *f*; 4 palmar angle spines; posterior margin of basis with 7 long setae, anterior margin without long setae.

Gnathopod 2: Posterior margin of basis with 4-5 long setae; anterior margin with 8 long setae. Propodus (fig. 10b): free posterior margin longer than in *f*, with 4 groups of setae. Palmar margin and claw shorter than in *f*.

Pereiopods 3 to 7 similar to those in *f*.

Epimeral plates 1 to 3 (fig. 10c): Ventral half

of posterior margin less strongly curved than in *f*, especially in plate 3. Ventral margin with 1, 1, and 2 spines, respectively.

Uropod 1: Peduncle with 1 proximoventral spine, 3 + 2 dorsal spines, and 2 mediobasal spines. Rami without dorsal spines.

Uropod 2: Rami without dorsal spines.

Uropod 3 (fig. 10d) slightly more slender than in *f*.

Telson (fig. 10e): More than twice as wide as long, rounded-rectangular; 1 long spine on each laterodistal corner; sensory setules implanted near basis of spine; distal margin practically straight, without emargination.

Etymology. — The name *unispinosus* refers to the single spine on the distolateral corners of the telson.

Remarks. — This is the only Canarian species with an unnotched telson; moreover, the telson is more than twice as long as wide, and carries only one spine on each laterodistal corner.

The following non-Canarian taxa agree with *Ps. unispinosus* in having an unnotched (or scarcely notched) telson and short third uropods: *unisexualis* Stock, 1980; *montanus* Notenboom, 1986; *illustris* Notenboom, 1987; *margalefi* Notenboom, 1987; *latipes* Notenboom, 1987; and *sorbasiensis* Notenboom, 1987. The first two species are from N.W. continental Spain, the remaining ones from southern continental Spain. None of these species agrees with *Ps. unispinosus* in telson shape and armature; moreover, the posterodistal lobe on the basis of pereiopods 5 to 7 in all these Iberian species is narrower than in *unispinosus*.

Although it is not customary to describe new taxa in the genus *Pseudoniphargus* on the basis of the female sex only, the present form is so well characterized by its telson morphology that it was thought justified to focus attention to it. I considered the possibility that *Ps. unispinosus* could be an aberrant specimen of the sympatrically occurring *Ps. fontinalis*. Apart from the telson morphology, small additional differences (lower number of denticles on the innermost spine of outer lobe of maxilla 1, armature of inner lobe of maxilliped, shape

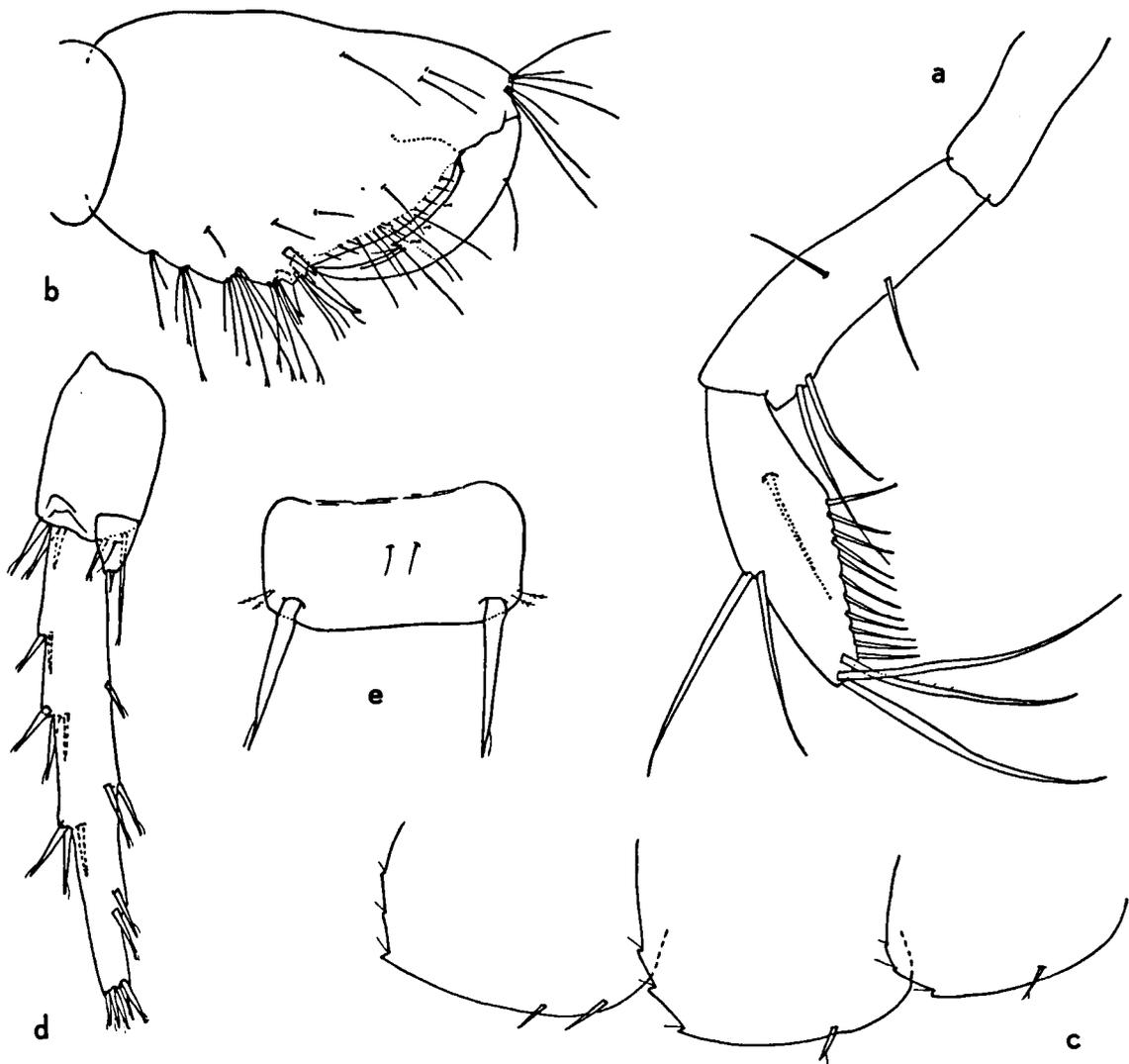


Fig. 10. *Pseudoniphargus unispinosus* n. sp., ♀ holotype: a, mandible palp (scale 7); b, distal part of gnathopod 2 (6); c, epimeral plates 1-3 (1); d, uropod 3 (6); e, telson (1). Scales on fig. 4.

propodus gnathopod 2, shape epimeral plates) have led me to consider *Ps. unispinosus* a different species.

Pseudoniphargus sp.

Material. — One juvenile. Tenerife, sta. 86-505, El Pris (= El Prix); well at the foot of the sea cliff, c. 6 m above sea level; UTM coordinates BS 36120 × 315460; temperature 20.7°C; conductivity 17.79 mS/cm (salinity c. 11.7 ppt); 26 Oct. 1986 (ZMA Amph. 108.374).
Accompanying fauna. — Amphipoda (*Bogidiella*).

Remark. — This juvenile must remain unidentified, but is recorded here to allow future workers to revisit the locality.

3.2 SPECIES FROM LA PALMA

Pseudoniphargus cupicola n. sp. (Figs. 11-13)

Material. — One ♂ (holotype), one ♀ (allotype), fifty-four paratypes. La Palma, sta. 87-06, El Porís, charcos de chochos (= man-made anchihaline pools, formerly used for the preparation of lupine seeds for human consumption); UTM coordinates BS 22680 × 315880; distance to the sea c. 30 m; stones, diatom growth; exposed to open sunlight; temperature 20.6°C; conductivity 18.04 mS/cm (salinity c. 11.9 ppt); 8 Apr. 1987 (ZMA Amph. 108.377a).

Other collections were made in the same charcos (pools) on 19 Nov. 1986 (sta. 86-554) and consist of 25 specimens (paratypes). In different pools the following range of

abiotic factors was observed: temperatures 20.2°-20.7°C, conductivities 23.5-25.2 mS/cm (salinities c. 15.75-17.1 ppt) (ZMA Amph. 108.377b).

Accompanying fauna. — Div. sp. Gastropoda, Planaria, Oligochaeta.

Description. — Body length of adults (both sexes) 5-6 mm. Ovigerous female with 11 eggs, egg size c. 0.31 × 0.38 mm. Colour pale salmon pink, no eyes.

Antenna 1 (fig. 11a) slightly longer than half the body length, resembling that of *Ps. brevipedunculatus*; accessory flagellum 2-segmented, short; flagellum 16-segmented; aesthetascs on segments 3 to 15, length about $\frac{3}{4}$ of corresponding flagellum segment in basal part of appendage, as long as segment in distal part.

Antenna 2 (fig. 11b) moderately slender, length c. 60% of antenna 1, moderately setose; flagellum 7-segmented.

Mandible palp as in *Ps. porticola*. First maxilla, outer lobe with 7 distal spines (figs. 11c-d), ornamented (from lateral to medial) with 1, 1, 0, 1, 0, 1, and 2 medial teeth (dissected female) or with 1, 0, 0, 1, 2, 1, and 1 medial teeth (dissected male); teeth, when present, large.

Inner lobe of maxilliped with 2 subdistal spines, 4 distal spines, and 4 distal setae.

Gnathopod 1 (fig. 11e): Coxal plate longer than wide. Basis with 7-12 posterior setae, 1-3 anterior setae, and 3-4 medial setae. Carpus elongated in both sexes (anterior margin of carpus as long as propodus); posterior margin with 5 groups of setae. Propodus not widened; posterior margin with 2 groups of setae; 6 palmar angle spines, similar in shape to those of *Ps. porticola*.

Gnathopod 2 (fig. 11f): Coxal plate with 4-8 setules. Coxal gill rather small. Basis with 8-10 posterior setae, 2-3 shorter and 3-4 longer anterior setae. Propodus relatively slender; posterior margin with 4 groups of setae; 3 palmar angle spines, the longest of which nearly twice as long as second-longest.

Posterior emargination of coxal plate 4 shallow (fig. 12a); ventral margin of plate with 5-6 setules only.

Pereiopods 5-7 (figs. 12b-d): Posterodistal

corner of basis with wide and shallow lobe, slightly better developed in male than in female; posterior margin of basis with c. 10 setules.

Epimeral plates 1-3 (fig. 13a) with 2, 3, and 3 ventral spines, respectively; posterior margin convex, with a few setules.

Uropod 1 (fig. 11g) resembling that of *Ps. porticola*; rami usually devoid of middorsal spines, sometimes 1 middorsal spine on exopodite.

Uropod 2 (fig. 11h): Peduncle with 2 dorsal spines and 1 + 2 distal spines; both rami with strong middorsal spine (rarely lacking).

Uropod 3: Peduncle short, exopodite in male rather strongly elongated (c. 13 × as long as greatest diameter), slightly upcurved and tapering (fig. 13b); in female (fig. 13c) exopodite somewhat elongated and tapering, hardly upcurved.

Telson (figs. 13d-e) slightly wider than long, rather similar to that of *Ps. porticola*; with 2-4 subdistal spines on lateral corner, no mediobasal spines. Sensory setules implanted at some distance from the basis of the spines. Distal emargination widely V-shaped, of moderate depth.

Etymology. — From the Latin words *cupa* (tub, alluding to the pools used for manufacturing lupine seeds) and *incola* (inhabitant).

Remarks. — In telson morphology, this species comes closest to *Ps. porticola* from water supply shafts in Tenerife. Whereas *porticola* lives in almost fresh drinking water, *cupicola* occurs in anchihaline pools of high salinity.

Morphologically, the two species can be distinguished by a number of differences: (1) the carpus of gnathopod 1 in *cupicola* is more elongate than in any other Canarian species, and bears more numerous tufts of setae on its posterior margin; (2) the propodus of gnathopod 1 in *porticola* is more widened and bears more setae on its posterior margin; (3) the propodus of gnathopod 2 of *cupicola* is more slender; (4) the shape of coxal plate 4 is rather different; this plate bears more setules in *porticola*; (5) the basis of pereiopods 5 to 7 bears

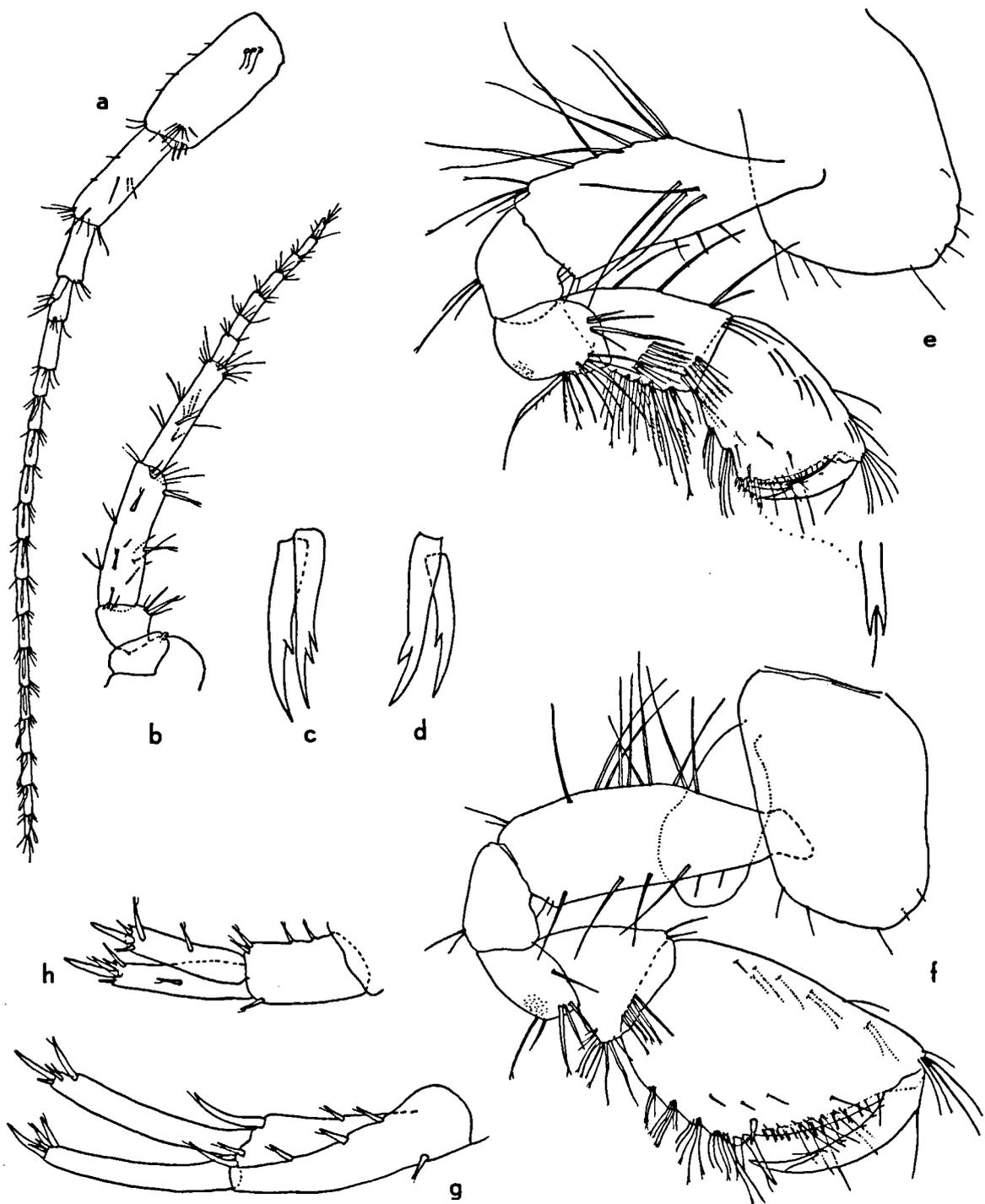


Fig. 11. *Pseudoniphargus cupicola* n. sp.: a, antenna 1, ♂ (scale 5); b, antenna 2, ♂ (5); c, medialmost spines of outer lobe of maxilla 1, ♀ (2); d, ditto, ♂ (2); e, gnathopod 1, ♀ (4); f, gnathopod 2, ♂ (4); g, uropod 1, ♂ (4); h, uropod 2, ♂ (4). Scales on fig. 4.

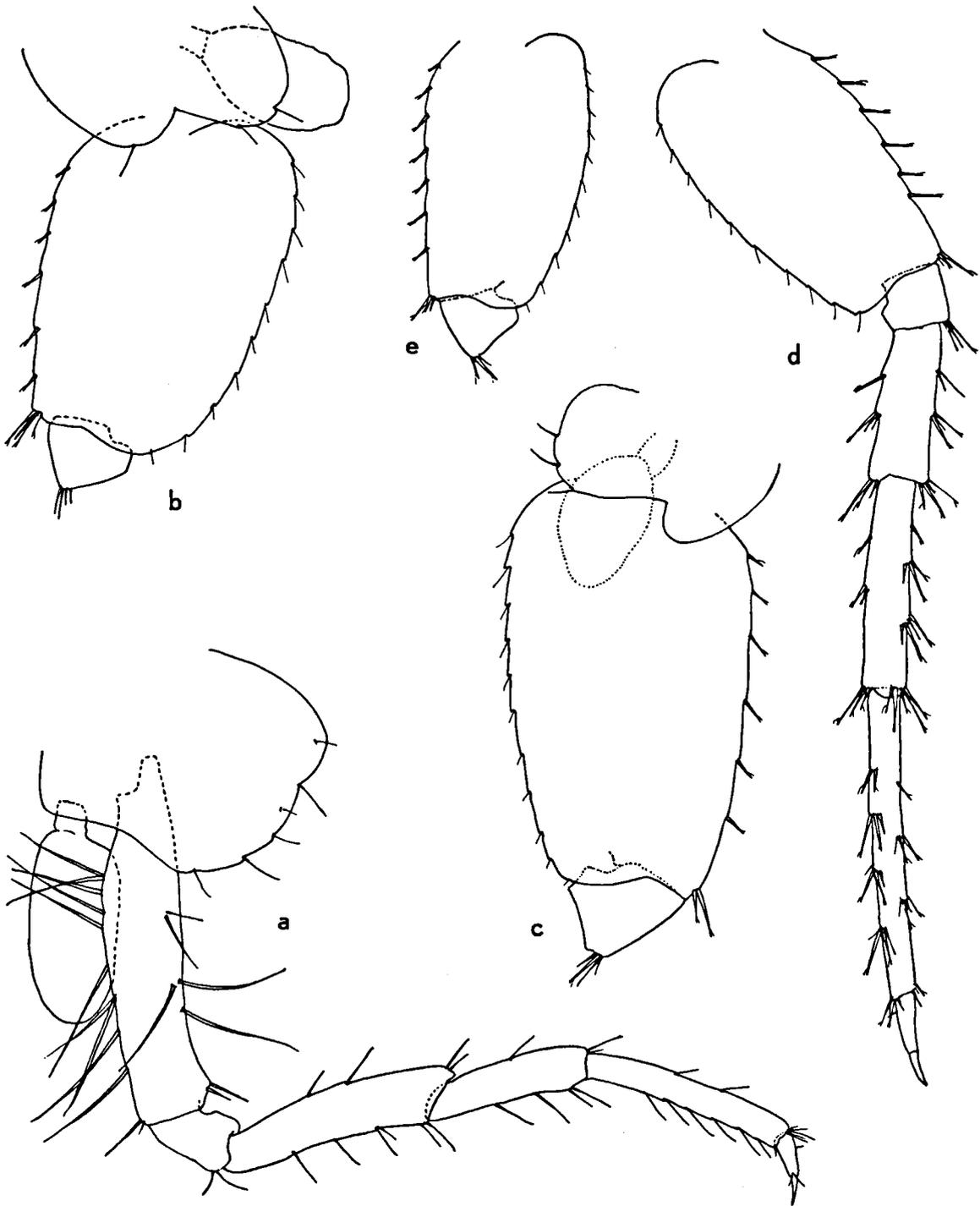


Fig. 12. *Pseudoniphargus cupicola* n. sp.: a, pereiopod 4, ♂ (scale 4); b, basal part of pereiopod 5, ♂ (4); c, basal part of pereiopod 6, ♂ (4); d, pereiopod 7, ♀ (5); e, basal part of pereiopod 7, ♂ (5). Scales on fig. 4.

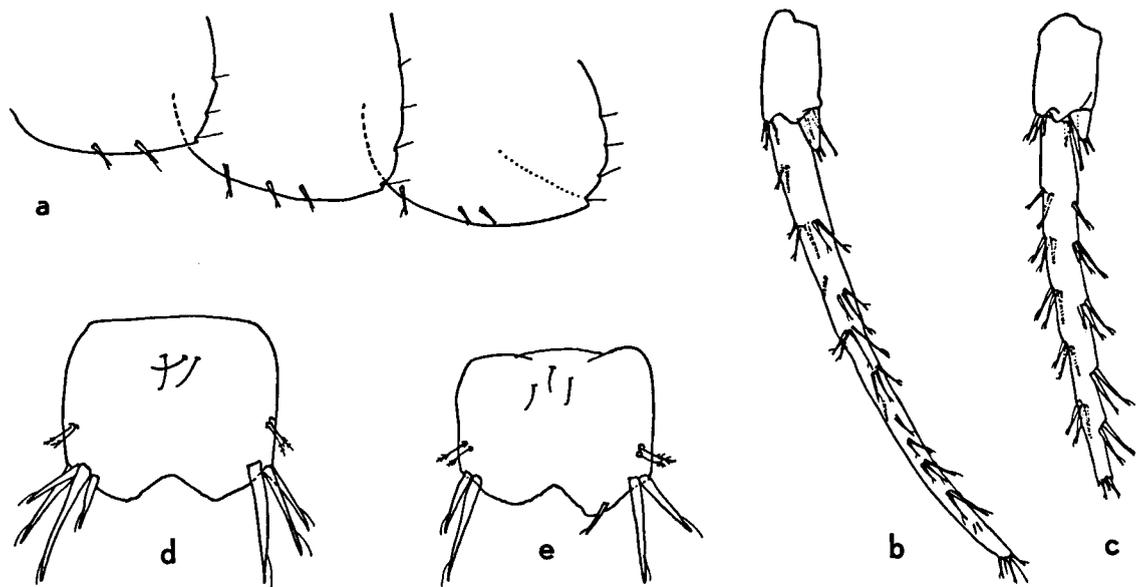


Fig. 13. *Pseudoniphargus cupicola* n. sp.: a, epimeral plates 1-3, ♂ (scale 5); b, uropod 3, ♂ (5); c, uropod 3, ♀ (5); d, telson, ♀ (6); e, telson, ♂ (6). Scales on fig. 4.

fewer posterior setules in *cupicola*; (6) the rami of uropod 2 are devoid of middorsal spines in *porticola*; (7) the peduncle of uropod 2 bears only 1 dorsal spine in *porticola*; (8) the space between the implantation of the subdistal telson spines and the sensory setules is larger in *cupicola*; (9) the spines on the outer lobe of maxilla 1 bear fewer teeth in *cupicola*. In character 9, *Ps. cupicola* differs from all other taxa discovered so far in the Canary Islands.

From *Ps. brevipedunculatus*, the new species differs in characters 5 and 9, mentioned above, and in a less deeply incised telson.

Pseudoniphargus multidens n. sp. (Figs. 14-15)

Material. — One ♂ (holotype), one ♀ (allotype), seven ♀♀ (paratypes). La Palma, sta. 87-07, Urbanización Urpal (= just S. of Santa-Cruz-de-la-Palma): UTM coordinates BS 22980 × 317370; old, neglected well, diameter c. 4 m, c. 100 m from the sea; water level at 8 m; water depth 0.25 m; temperature 19.7°C; conductivity 2.57 mS/cm (salinity c. 1.5 ppt); 8 Apr. 1987 (ZMA Amph. 108.375a).

Four small specimens (paratypes), same locality, sta. 86-561; temperature 17.3°C; conductivity 2.52 mS/cm; 21 Nov. 1986 (ZMA Amph. 108.375b).

Accompanying fauna. — *Physa* (Gastropoda), Planaria, Cyclopidae, larvae of Diptera.

Description. — Length of male holotype 5.5 mm, of female allotype (with long but non-setose oostegites) 5.5 mm; paratypes smaller. Body colourless; blind.

Closely related to *Ps. cupicola* (abbreviated *P. c.*), likewise from La Palma.

Antenna 1: Flagellum 16-segmented; proximal aesthetascs about half, distal ones about $\frac{2}{3}$ as long as corresponding flagellum segments; otherwise similar to that of *P. c.*

Antenna 2: Flagellum 8-segmented, otherwise similar to that of *P. c.*

Mandible palp (fig. 14a): Most proximal D-seta twice as long as next D-setae; only 3 E-setae.

Maxilla 1: Outer lobe with 7 distal spines (fig. 14g), ornamented (from lateral to medial) with 1, 1, 1, 1, 1, 1, and 4 small teeth (male holotype) or 1, 1, 1, 1, 2, 2, and 4 small teeth (female paratype). Inner lobe of maxilliped as in *P. c.*

Gnathopod 1 (fig. 14b): Medial surface of basis with 2-4 long setae, posterior margin with 9-12 long setae. Merus with bunch of 4

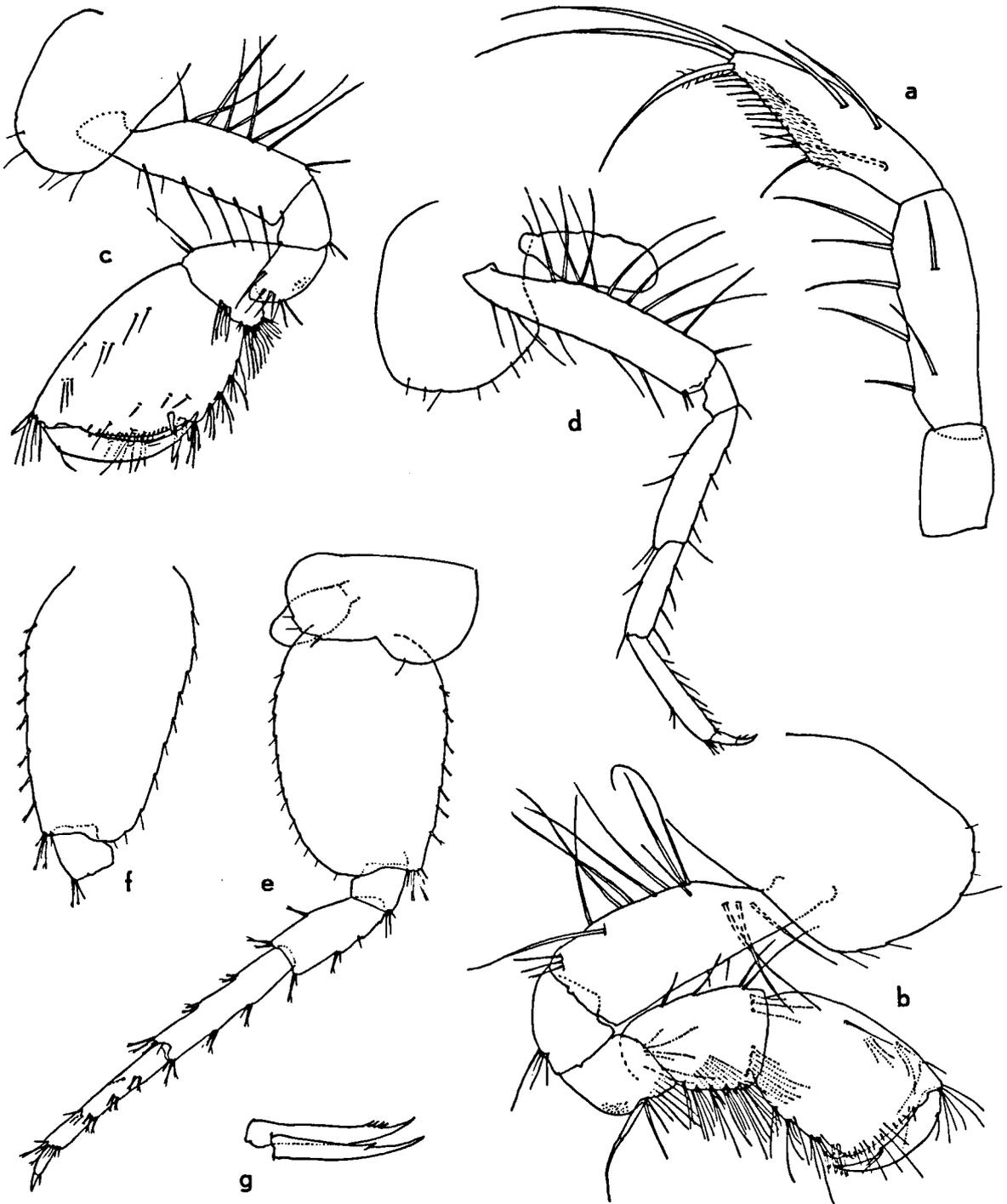


Fig. 14. *Pseudoniphargus multidentis* n. sp.: a, mandible palp, ♀ (scale 1); b, gnathopod 1, ♂ (4); c, gnathopod 2, ♂ (4); d, pereopod 4, ♂ (5); e, pereopod 5, ♂ (5); f, basis of pereopod 5, ♀ (5); g, medialmost spines of outer lobe of maxilla 1, ♂ (2). Scales on fig. 4.

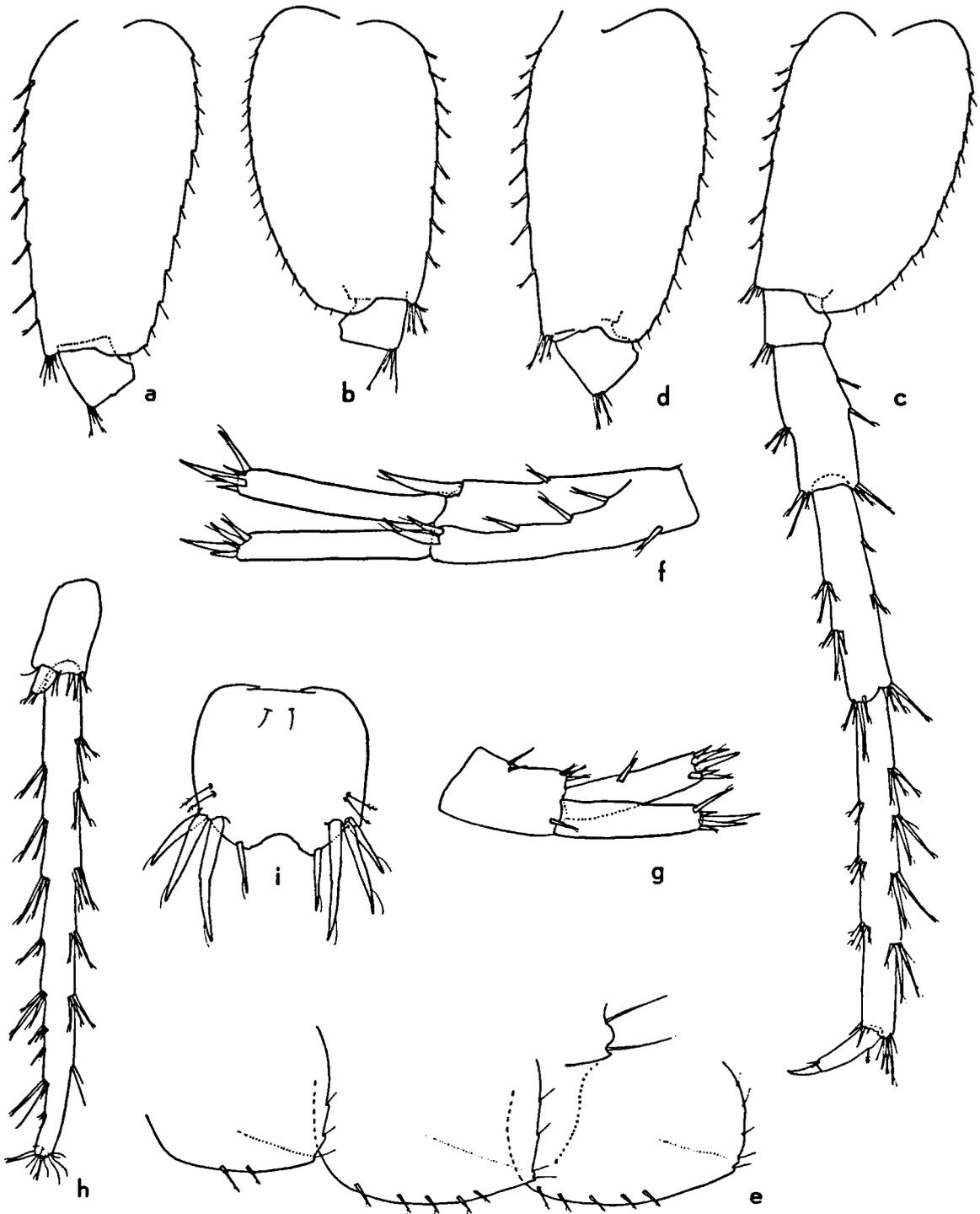


Fig. 15. *Pseudoniphargus multidens* n. sp.: a, basis of pereopod 6, ♀ (scale 5); b, same of ♂ (5); c, pereopod 7, ♂ (5); d, basis of pereopod 7, ♀ (5); e, epimeral plates 1-3, ♂ (5); f, uropod 1, ♂ (4); g, uropod 2, ♂ (4); h, uropod 3, ♂ (5); i, telson, ♂ (6). Scales on fig. 4.

anterodistal setae. Carpus trapezoidal, somewhat elongated, but less than in *P. c.*; posterior margin with 5 groups of setae. Posterior margin of propodus with 3 or 4 groups of setae.

Gnathopod 2 (fig. 14c): Posterior margin of basis with 8-11 long setae. Posterior margin of propodus with 4 or 5 groups of setae; largest palmar angle spine twice as long as second-longest.

Pereiopod 4 (fig. 14d): resembling that of *P. c.*

Basis of pereiopod 5 (figs. 14e-f) sexually dimorphic: in the male the posterior margin is convex, with a wide, rounded, rather shallow distal lobe; in the female it is almost straight, the lobe being less wide and truncate; in the male there are c. 13 setules on the posterior margin, in the female 10.

The same sexual dimorphism exists in the basis of pereiopods 6 and 7 (figs. 15a-d); the number of setules on posterior margin of basis is 19 (male) or 13 (female) in P6, and 17 (male) or 15 (female) in P7.

Epimeral plates 1-3 with 2, 4 or 5, and 5 ventral spines, respectively (fig. 15e); posteroventral corner of plates 2 and 3 with 2 closely inserted setules.

Uropods 1 (fig. 15f) and 2 (fig. 15g) similar to those of *P. c.*

Uropod 3 male (fig. 15h): peduncle short; exopodite slightly upcurved, elongate, 13-14 times as long as wide, armed with long spines and a few setules. Uropod 3 female similar to that of *P. c.*

Telson (fig. 15i) as long as wide or slightly wider than long, resembling that of *P. c.*, but for the presence of an extra spine on the mediodistal end of each telson lobe.

Etymology. — The specific name *multidens* (Latin, with many teeth) alludes both to the ornamentation of the spines of the outer lobe of maxilla 1, and to the armature of the ventral margin of the epimera.

Remarks. — Though resembling *Ps. cupicola* in having an elongate carpus of gnathopod 1, the posterior margin of which bears numerous (5) groups of setae, there exist too many dif-

ferences between the animals described above from a fresh well and *Ps. cupicola* from salty pools to be considered conspecific. The major differences pertain to (1) the greater number of teeth on the medialmost spine of the outer lobe of maxilla 1, (2) the presence of a mediodistal telson spine, (3) the greater number of spines on the epimera and the twin setules on their posteroventral corner, and (4) the more strongly pronounced sexual dimorphism in the basis of pereiopods 5 to 7.

***Pseudoniphargus* sp.**

At sta. 87-09 in La Palma, 7 adults (including 1 ♂ of 4.5 mm and 1 ♀ with 3 eggs of 4.1 mm) and 8 juveniles were collected that agree with *Ps. multidens* in the armature of the spines of the outer lobe of maxilla 1. These specimens were washed from sand in a so-called "mineral spring" known by the name of Charco Verde (= S. of Puerto Naos, UTM coordinates BS 2171 × 31640). The "spring" is a polluted open puddle with a rocky bottom and rich in mosquito larvae. Some marine debris (*Posidonia* leaves, dead hydroid stems) were introduced by wind or waves. Temperature 23.3°C, conductivity 6.76 mS/cm (salinity c. 4.2 ppt); 9 Apr. 1987 (ZMA Amph. 108.376). Accompanying fauna. — Oligochaeta (Tubificidae).

The single male was dissected and might be subadult. In most characters (with the exception of maxilla 1) it resembles strongly *Ps. cupicola*. Further material is necessary to allow a decision about the taxonomic status of this population.

Furthermore, a single damaged specimen (lacking its urosome) of *Pseudoniphargus* was encountered at sta. 87-10A. This specimen resembles the material from sta. 87-09 mentioned above very closely.

The data for this station are: Comunidad de Agua Los Palacias (= N. of Puerto Naos); UTM coordinates BS 2143 × 31681; galería for water production; in a water basin c. 500 m from the entrance; completely dark; depth c. 1.5 m; temperature 18.8°C; conductivity 1.51 mS/cm; 9 Apr. 1987 (ZMA Amph. 108.377).

3.3 SPECIES FROM LA GOMERA

***Pseudoniphargus gomerae* n. sp.** (Figs. 16-18)

Material. — One ♀ with setose oostegites (holotype), one ♂ (allotype), fifty-one paratypes. La Gomera, sta. 87-

24; Pozo del Avalo, just above sea level at Playa del Avalo; UTM coordinates BS 29345 × 311100; completely dark, cave-like well with short (c. 15 m) galería; polluted by gas oil from motorpump; mud, stones; temperature 22.7°C; conductivity 1886 µS/cm (salinity c. 1 ppt); 21 Apr. 1987 (ZMA Amph. 108.378).

One ♂, same locality, sta. 86-583; temperature 22.6°C; conductivity 1875 µS/cm; 29 Nov. 1986 (ZMA Amph. 108.381a).

One ♀, one juv., probably this species; sta. 86-585; well in Barranco Hondo (Playa de San Sebastian); UTM coordinates BS 29252 × 310848; large open well (diameter c. 5 m) with fish (*Mugil*) and filamentous algae; temperature 23.3°C; conductivity 5.64 mS/cm (salinity c. 3.3 ppt); 29 Nov. 1986 (ZMA Amph. 108.381b).

A small specimen, probably this species; sta. 87-26; Playa de San Sebastian; well on the beach; UTM coordinates BS 29238 × 310930; temperature 24.4°C; conductivity 31.6 mS/cm (salinity c. 22 ppt); 21 Apr. 1987 (ZMA Amph. 108.381c).

Accompanying fauna. — In the type-locality: Oligochaeta; in sta. 87-583: Ostracoda, Cyclopoida.

Description. — Colour white, blind. Females with oostegites 4.5-5 mm, male 4.5 mm. In the morphology of most appendages, very similar to *Ps. multidentis* from La Palma, but differing at first sight by the absence of sexual dimorphism in uropod 3.

Antenna 1 (figs. 16a-b) about half as long as body; flagellum of up to 16 segments; aesthetascs on segments 5 to 15, 60-70% of length of corresponding flagellum segment (except that on segment 15 which is as long as segment 16).

Antenna 2 (fig. 16c) slightly longer than half the length of antenna 1; flagellum 8-segmented.

Mandible palp (fig. 17a): 6-8 setae ventrally and subventrally on segment 2; segment 3 with 1 A-seta, 1 or 2 B-setae, up to 13 D-setae (first the longest), and 4 E-setae.

Maxilla 1: Spines on outer lobe in two appendages of two different specimens ornamented as follows (from lateral to medial): 1, 0, 2, 1, 2, 2, and 4, or 1, 0, 1, 1, 1, 2, and 3.

Maxilliped: Inner lobe with 2 subdistal setae, 4 distal setae and 4 distal spines.

Gnathopod 1 (fig. 16d): Coxal plate with some 9 ventral setules, some of these relatively long. Basis with up to 4 long setae on medial surface; posterior margin with about 9 long setae, anterior margin with short setae only. Merus with bunch of 4 anterodistal setae.

Carpus slightly elongated, trapezoidal; posterior margin with 5 groups of setae, anterior margin with 2 setae. Propodus not enlarged; posterior margin with 3 groups of setae; 6 bifid palmar angle spines (of same shape as in *Ps. multidentis*).

Gnathopod 2 (fig. 16e): Coxal plate armed as in gnathopod 1. Basis with c. 8 long setae on posterior margin and several short setae on anterior margin. Propodus large, with 4 or 5 groups of setae on posterior margin; 3 palmar angle spines, the longest being distinctly more than twice as long as the second-longest.

Pereiopods 3 and 4 (fig. 17b): Setules on coxal plate rather long, otherwise similar to those of *Ps. multidentis*.

Basis of pereiopods 5 to 7 (figs. 17c-e, 18a-d) sexually dimorphic: posteroventral lobe in male more strongly overhanging than in female, and posterior margin in male convex, in female almost straight. In these features, *Ps. gomerae* resembles *Ps. multidentis*. Posterior margin of basis of P5 with 7-11 setules, anterior margin with 4-5 spinules; for P6 these numbers are 9-12 and 7-9; and for P7 10-13 and 5-6.

Epimeral plates (fig. 18g) with fewer spines than in *Ps. multidentis* (0-1 on plate 1; 2-3 on plate 2, 2-4 on plate 3); posterior margin faintly serrate, with 3-6 setules.

Uropod 1 (fig. 17f): Peduncle with 1 (sometimes 2) long, upcurved medioterminal spines [spine(s) 1.5-2 times as long as lateroterminal spine]; small proximoventral spine. Exopodite or endopodite sometimes with 1 middorsal spinule, often without.

Uropod 2 (fig. 16f): Exopodite with 0-2 middorsal spinules.

Uropod 3 (figs. 18h-i) not sexually dimorphic, hardly at all elongated.

Telson (figs. 18e-f): Distal emargination rather narrow, V-shaped, reaching to level of implantation of laterodistal spines. Number of spines variable: 2 to 3 long laterodistal spines; usually none, sometimes 1, short mediodistal spine. Sensorial setules implanted at some distance of the subdistal spines.

Etymology. — Named after the island of La Gomera.

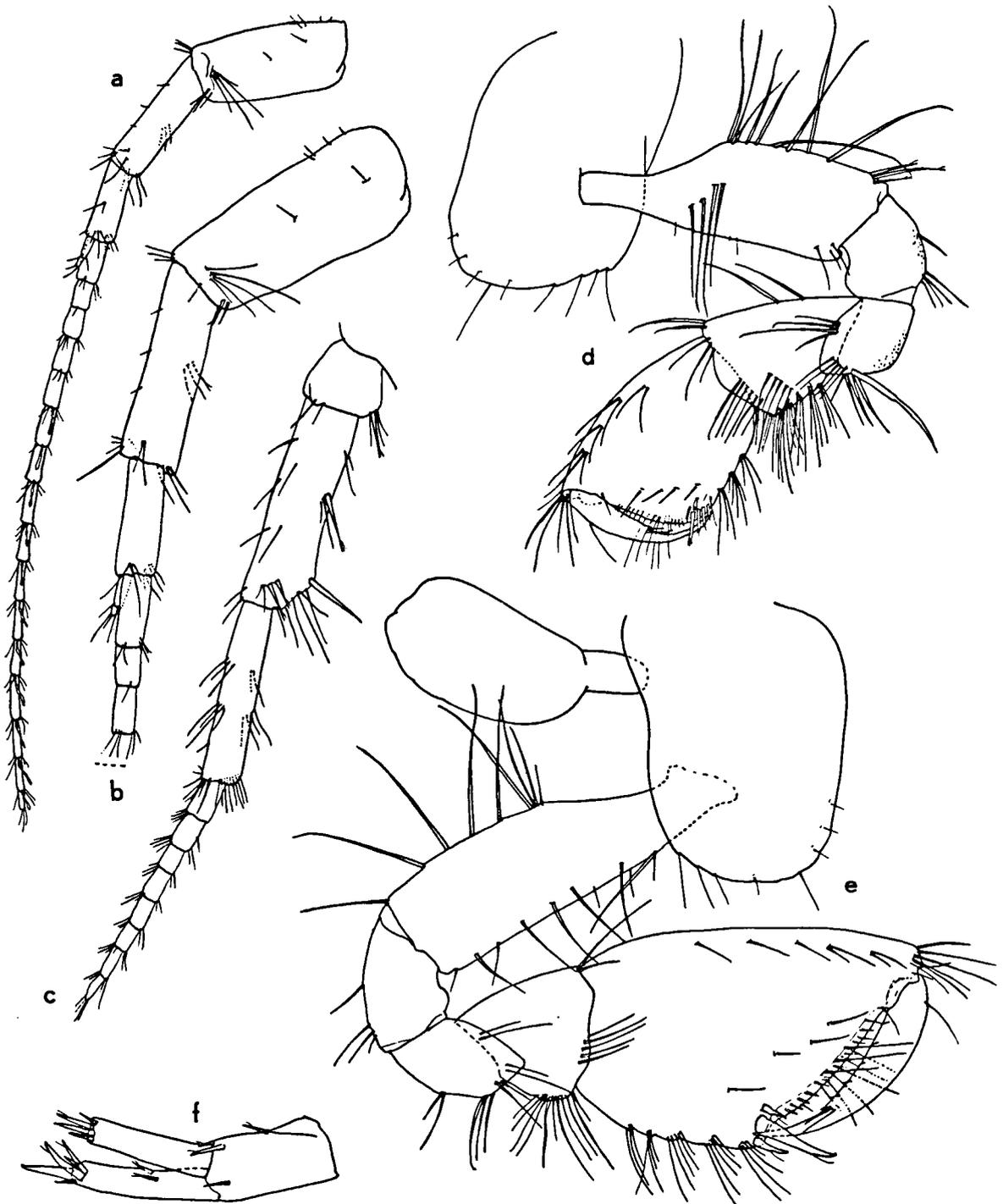


Fig. 16. *Pseudoniphargus gomeræ* n. sp.: a, antenna 1, ♀ (scale 5); b, basal part of antenna 1, ♀ (4); c, antenna 2, ♀ (4); d, gnathopod 1, ♀ (4); e, gnathopod 2, ♀ (4); f, uropod 2, ♀ (4). Scales on fig. 4.

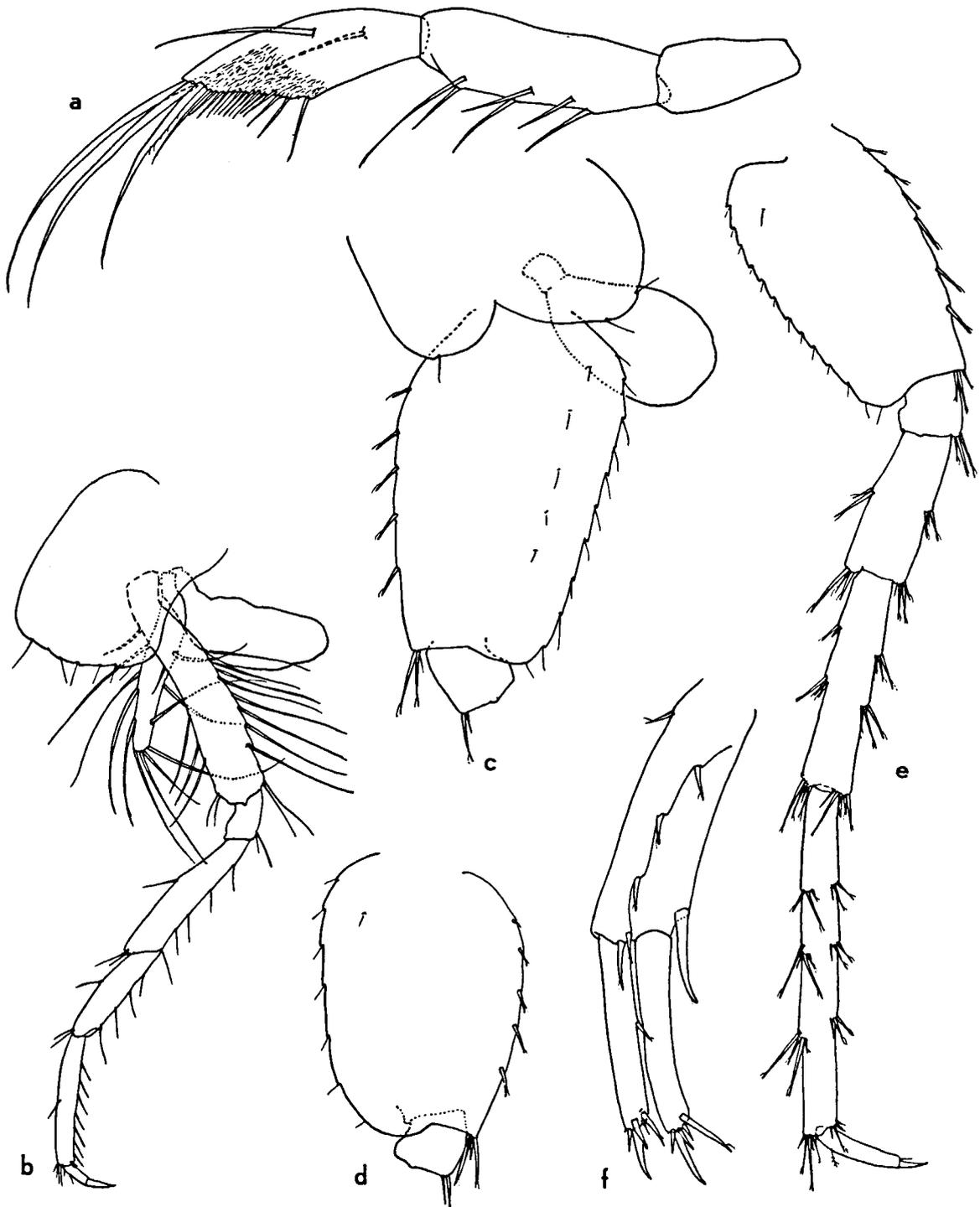


Fig. 17. *Pseudoniphargus gomeræ* n. sp.: a, mandible palp, ♀ (scale 1); b, pereiopod 4, ♀ (5); c, basal part of pereiopod 5, ♀ (4); d, basis of pereiopod 5, ♂ (4); e, pereiopod 7, ♀ (5); f, uropod 1, ♀ (4). Scales on fig. 4.

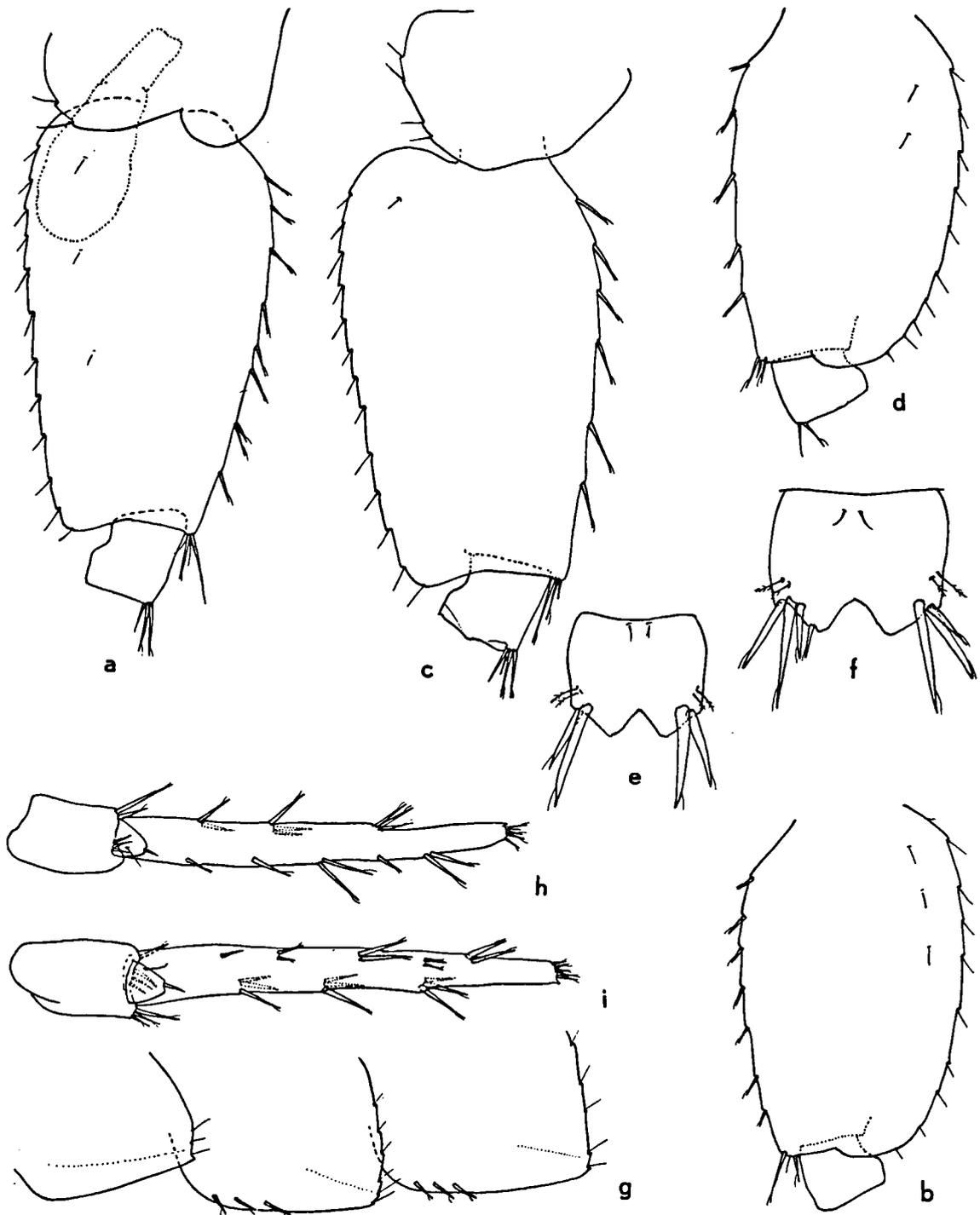


Fig. 18. *Pseudoniphargus gomeræ* n. sp.: a, basal part of pereopod 6, ♀ (scale 4); b, basis of pereopod 6, ♂ (4); c, basal part of pereopod 7, ♀ (4); d, basis of pereopod 7, ♂ (4); e, telson, ♂ (6); f, telson, ♀ (6); g, epimeral plates 1-3, ♀ (5); h, uropod 3, ♂ (4); i, uropod 3, ♀ (4). Scales on fig. 4.

Remarks. — As stated above, this species is very close to *Ps. multidens* from La Palma, differing mainly by the different width and depth of the telson cleft and by the undifferentiated third male uropod.

Likewise, this species is very similar to *Ps. salinus* from El Hierro, but differing in the telson (which is much wider in relation to its length in *Ps. salinus*), in the lower number of setal groups on the carpus of gnathopod 1, and in the less elongate first antenna.

The sample from the type-locality, consisting of 53 specimens, has a skewed sex ratio, females being much more numerous than males.

3.4 SPECIES FROM EL HIERRO

Pseudoniphargus salinus n. sp. (Figs. 19-21)

Material. — One ♀ with setose oostegites (holotype), one ♂ (allotype) and six paratypes. El Hierro, sta. 87-40, seawater pumps of swimming pool of UNELCO (= electricity plant); UTM coordinates BR 21360 × 307580; anchihaline; dark; temperature 24.4°C; conductivity 34.1 mS/cm (salinity c. 24 ppt); 28 Apr. 1987 (ZMA Amph. 108.379).

Twenty-seven small specimens, probably this species; sta. 87-48, La Restinga, Jameos (= cave) del Puerto; UTM coordinates BR 20595 × 306077; anchihaline cave, with tidal influence and several marine animals (starfish, *Mugil*); method Karaman-Chappuis in intertidal cinder grit; clear water; semi-dark; temperature 20.9°C; conductivity 35.8 mS/cm (salinity c. 25.3 ppt); 30 Apr. 1987 (ZMA Amph. 108.382a).

Two fragmentary specimens; sta. 87-43; Poyata (100 m E. of La Salud), small closed well c. 10 m from the sea; UTM coordinates AR 19467 × 307383; temperature 20.8°C; conductivity 11.52 mS/cm (salinity c. 6.3 ppt); 29 Apr. 1987 (ZMA Amph. 108.382b).

Eight specimens; sta. 87-41, Pozo la Salud (mineral, medicinal well); UTM coordinates AR 19417 × 307395; closed well, c. 6 m from the sea, in rock; temperature 23.1°C; conductivity 14.2 mS/cm (salinity c. 9.1 ppt); 28 Apr. 1987 (ZMA Amph. 108.382c).

Accompanying fauna. — In the type-locality none. In sta. 87-48, a number of epigeal marine animals was found, but also the hypogean amphipod *Bogidiella* and the interstitial snail *Caecum*. In sta. 87-41 some gastropods were found, in sta. 87-43 some ostracods.

Description. — Colour white, blind. Ovigerous female carrying 3 eggs. Female 5.5 mm, male 4 mm.

Antenna 1 (fig. 19a) half as long as body. Peduncle segments 2 and 3 more elongate than in other Canarian species. Flagellum also elongate, 17-segmented (both sexes); aesthetascs on segments 3-16, 60-80% of the length of corresponding flagellum segment.

Antenna 2 (fig. 19b) slightly more than half the length of antenna 1. Peduncle segments 4 and 5 thin and slender. Flagellum 7-segmented.

Mandible palp (fig. 19c): Segment 2 with rather numerous (c. 10) ventral and subventral setae; segment 3 with 1 A-seta, 2 B-setae, c. 14 D-setae, and 4 E-setae.

Maxilla 1, outer lobe with 7 spines, ornamented from lateral to medial with 1, 2, 2, 2, 2, 2, and 3 small denticles (fig. 19d).

Maxilliped, inner lobe with 2 subdistal setae, 4 distal setae and only 3 distal spines.

Gnathopod 1 (fig. 19e): Lower margin of coxal plate with 3-4 long setae. Basis with 4 medial setae, 5-9 long posterior setae, and 2-3 short anterior setae. Merus with 4 distal setae. Carpus elongate in both sexes, with 3 groups of posterior setae, 1 group of posterodistal setae, 2 rows of medial setae, and 4 (groups of) anterior setae. Propodus not widened, posterior margin with 3 groups of setae; 6 bifid palmar angle spines.

Gnathopod 2 (fig. 19f): Posterior margin of basis with 5-6 long setae; anterior margin with 2-4 shorter, proximal setae, and 2-4 longer and 2-3 shorter distal setae. Propodus not enlarged, posterior margin with 4 groups of setae; 3 palmar angle spines, longest of which about twice as long as second-longest.

Pereiopod 4 (fig. 20a): Coxal plate with very shallow posterior emargination.

Pereiopod 5 (figs. 20b-c): Basis with slight sexual dimorphism (posterior margin of female straighter than in male; posteroventral lobe of male slightly larger); anterior margin with low number of spinules (3-5); posterior margin with few setules (8-10).

Pereiopods 6 and 7 (figs. 20d-g) show tendencies similar to P5. Distal segments (merus, carpus, propodus) more elongate than in related species.

Epimeral plates 1 to 3 (fig. 21a): Ventral

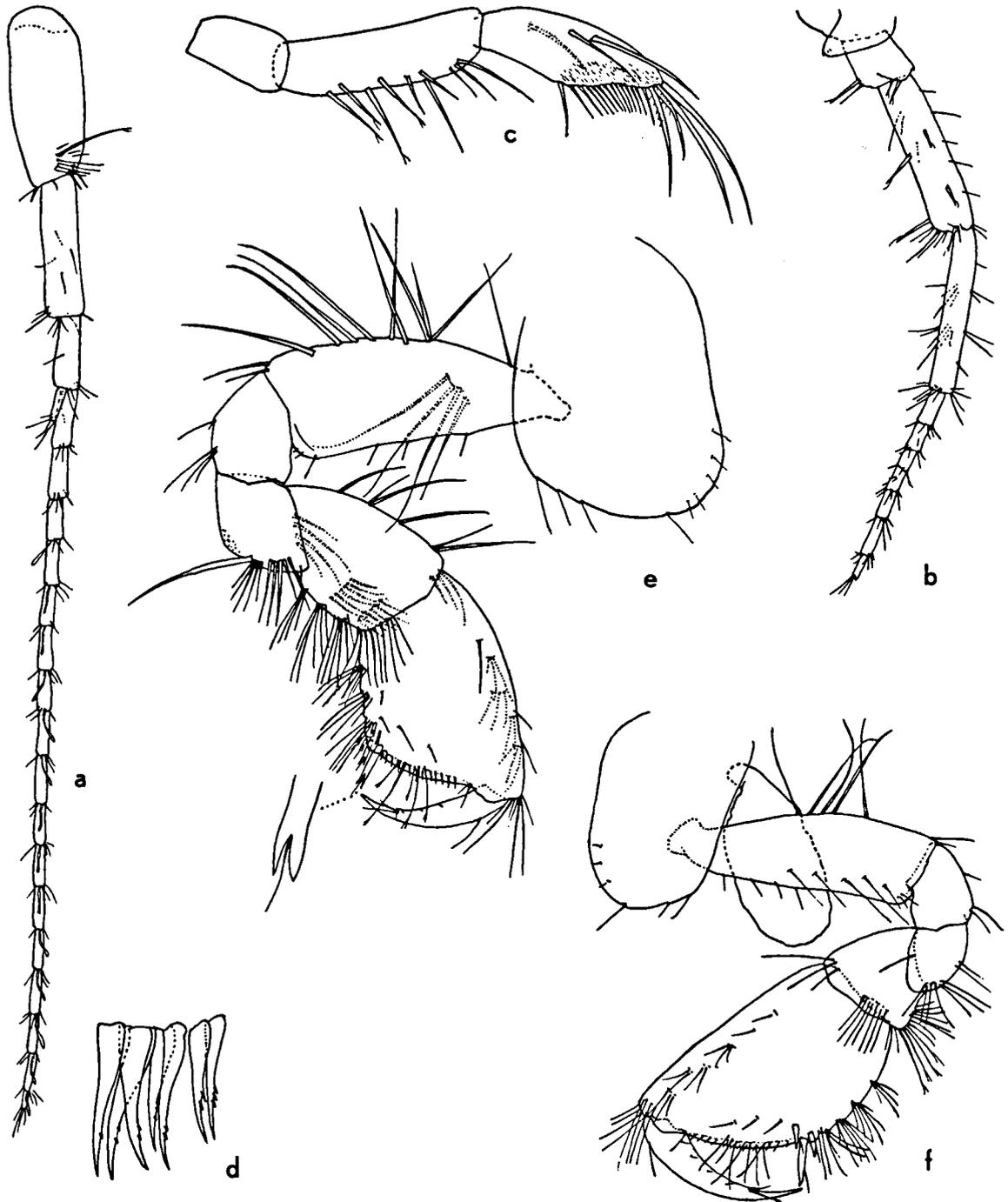


Fig. 19. *Pseudoniphargus salinus* n. sp.: a, antenna 1, ♀ (scale 5); b, antenna 2, ♀ (5); c, mandible palp, ♀ (6); d, spines of outer lobe of maxilla 1, ♀ (8); e, gnathopod 1, ♀ (4); f, gnathopod 2, ♀ (5). Scales on fig. 4.

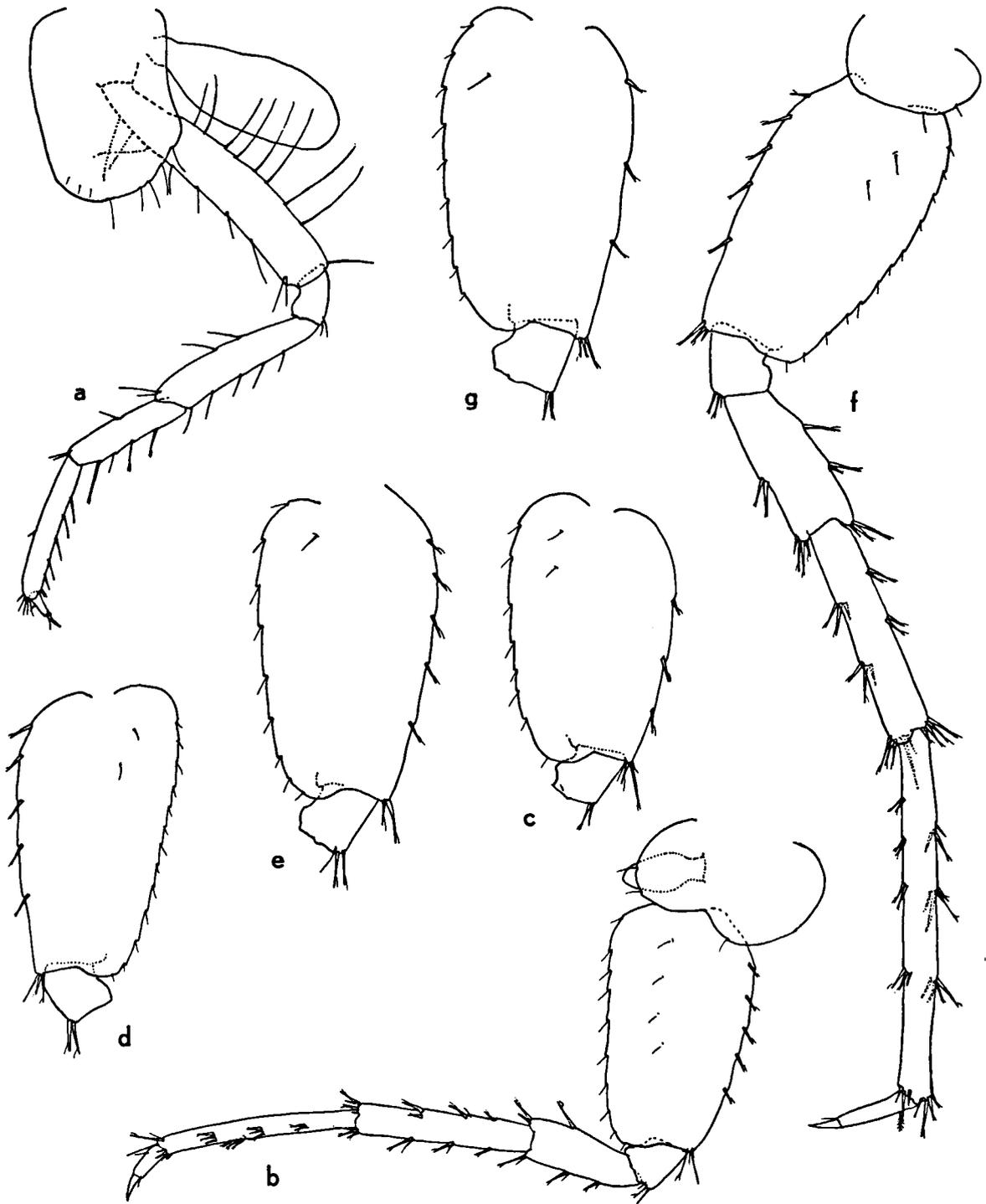


Fig. 20. *Pseudoniphargus salinus* n. sp.: a, pereiopod 4, ♀ (scale 5); b, pereiopod 5, ♀ (5); c, basis of pereiopod 5, ♂ (4); d, basis of pereiopod 6, ♀ (5); e, basis of pereiopod 6, ♂ (4); f, pereiopod 7, ♀ (5); g, basis of pereiopod 7, ♂ (4). Scales on fig. 4.

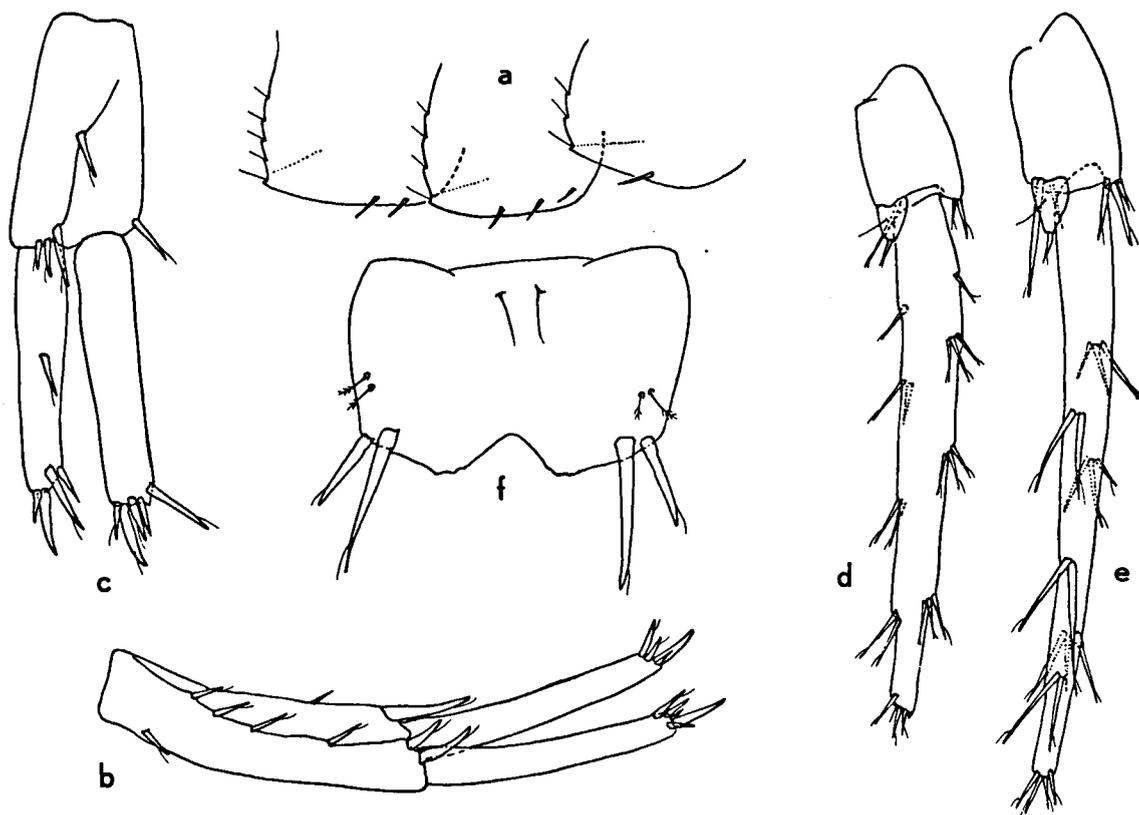


Fig. 21. *Pseudoniphargus salinus* n. sp.: a, epimeral plates 1-3, ♀ (scale 5); b, uropod 1, ♀ (4); c, uropod 2, ♀ (6); d, uropod 3, ♀ (4); e, uropod 3, ♂ (6); f, telson, ♀ (1). Scales on fig. 4.

margin with 1, 3, and 2 spines, respectively. Posterior margin serrate, with 3-5 setules.

Uropod 1 (fig. 21b): Peduncle with 1 dorsomedial spine, and small proximoventral spine; 1 distomedial spine, 2 shorter distolateral spines. Rami without middorsal armature.

Uropod 2 (fig. 21c): Exopodite with or without mediodorsal spine.

Uropod 3 (figs. 21d-e): Without strong sexual dimorphism (exopodite of male slightly more curved and tapering than in female). Lateral and medial spines of exopodite long.

Telson (fig. 21f) much wider than long. Two laterodistal spines on each corner; sensorial setules implanted at some distance from the spines. Distal emargination rather narrow, broadly V-shaped, reaching to level of implantation of laterodistal spines.

Etymology. — The specific name *salinus* alludes to the high salinities at which this species was found.

Remarks. — In the elongation of the carpus, this species is reminiscent of *Ps. cupicola* from La Palma and *Ps. gomerae* from La Gomera. It differs from *cupicola* by the absence of strong sexual dimorphism in uropod 3, in greater slenderness of certain appendages (A1, A2, P6, P7), and in smaller but more numerous denticles on the distal spines of the outer lobe of maxilla 1. For differences with *Ps. gomerae*, see under the latter species.

***Pseudoniphargus* sp.**

Material. — One fragmentary specimen. El Hierro, sta. 87-42, Pozo de Hoya del Veronal; UTM coordinates

AR 18965 × 307407; open, round well; diameter c. 2.5 m; water level at -80 m; water depth 1.5 m; temperature 21.2°C; conductivity 3.24 mS/cm (salinity c. 2 ppt); 28 Apr. 1987 (ZMA Amph. 108.380).
Accompanying fauna. — Ostracoda, Hydracarina.

Remarks. — It is impossible to identify this single, fragmentary specimen. The salinity at which it was caught is much lower than in localities at which *Ps. salinus* occurs, hence this material might represent another species.

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REFERENCES

- ABDEL-MONEM, A., N. D. WATKINS & P. W. GAST, 1971. Potassium-Argon ages, volcanic stratigraphy, and geomagnetic polarity history of the Canary Islands. *Am. J. Sci.*, **271**: 490-521.
- CHEVREUX, E., 1901. Amphipodes des eaux souterraines de France et d'Algérie, V. *Pseudoniphargus africanus* nov. gen. et sp. *Bull. Soc. zool. Fr.*, **26**: 211-216.
- GRUNAU, H. R., P. LEHNER, M. R. CLEINTUAR, P. ALLENBACH & G. BAKKER, 1975. New radiometric ages and seismic data from Fuerteventura (Canary Islands), Maio (Cape Verde Islands) and São Tomé (Gulf of Guinea). In: J. BORRADAILE et al., *Progress in geodynamics*: 90-118 (Kon. Ned. Akad. Wet., Amsterdam).
- KARAMAN, G. S., 1978. Revision of the genus *Pseudoniphargus* Chevreux 1901 (fam. Gammaridae). *Boll. Mus. civ. Stor. nat. Verona*, **5**: 239-258.
- MITCHELL-THOMÉ, R. C., 1982. The geological settings and characteristics of the Atlantic islands. *Acta geol. Acad. sci. Hung.*, **25**: 395-420.
- NOTENBOOM, J., 1986. The species of the genus *Pseudoniphargus* Chevreux, 1901 (Amphipoda) from northern Spain. *Bijdr. Dierk.*, **56**: 75-122.
- , 1987a. Species of the genus *Pseudoniphargus* Chevreux, 1901 (Amphipoda) from the Betic Cordillera of southern Spain. *Bijdr. Dierk.*, **57**: 87-150.
- , 1987b. Lusitanian species of the amphipod *Pseudoniphargus* Chevreux, 1901 with a key to all known Iberian species. *Bijdr. Dierk.*, **57**: 191-206.
- SCHMINCKE, H.-U., 1973. Magmatic evolution and tectonic regime in the Canary, Madeira and Azores island groups. *Bull. geol. Soc. Amer.*, **84**: 633-648.
- STOCK, J. H., 1980. Regression model evolution as exemplified by the genus *Pseudoniphargus* (Amphipoda). *Bijdr. Dierk.*, **50**: 105-144.
- , 1985. The amphi-Atlantic and insular distribution of *Pseudoniphargus*. Preprint Proc. VIth int. Colloquium on Amphipoda (Ambleteuse, France), 1 p.
- , in press a. Insular groundwater biotas in the (sub)tropical Atlantic — a biogeographic synthesis. *Proc. int. Symp. biogeogr. Aspects Insularity* (Atti r. Accad. Lincei, Roma).
- , in press b. A new Rhipidogammarus (Crustacea, Amphipoda) from Tenerife: first record of the genus outside the Mediterranean and its biogeographic implications. *Hydrobiologia*.
- , in press c. Comparaison des stygofaunes des îles calcaires et volcaniques de l'Atlantique tropical. *Mém. Soc. Biospéol.*
- STOCK, J. H., J. R. HOLSINGER, B. SKET & T. M. ILIFFE, 1986. Two new species of *Pseudoniphargus* (Amphipoda), in Bermudian groundwaters. *Zoologica Scr.*, **15**: 237-249.