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Sinogammarus troglodytes n. gen. n. sp. A new troglobiont Gammarid from China (Crustacea Amphipoda)

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SUMMARY

The authors describe *Sinogammarus troglodytes* n. gen. n. sp. found in two caves in Sichuan province in China, the first Chinese troglobite of the Gammaridae family (sensu Barnard & Barnard, 1983; 1990). The new genus is discussed and compared with the microphthalmous and anophthalmous genera of Gammaridae, heretofore known in the subterranean waters of the Balkan peninsula and the Caucasus region. The genus *Sinogammarus* is most closely allied to *Gammarus* Fabricius and *Anopogammarus* Derzhavin.

The cavernicolous fauna of China is virtually unknown. In particular, only three troglobiont amphipods have been identified in the Chinese Republic: *Pseudocrangonyx asiaticus* Ueno, 1934, *Pseudocrangonyx manchuricus* Oguro, 1938 from the subterranean waters in northeastern China, and *Bogidiella sinica* G. Karaman & Sket, 1990, found in a cave in southern China (G. Karaman & Sket, 1990).

The discovery of a large anophthalmous amphipod in two caves in Sichuan province during a speleological expedition in China organized by the Centro Ibleo di Ricerche Speleo-idrologiche (Ragusa, Sicily), is therefore particularly noteworthy. A study of the material, which was so kindly sent to us for this purpose, has enabled us to establish that this is a new species of Gammaridae (sensu Barnard & Barnard, 1983; 1990) that cannot be assigned to any other known genus.

The present article gives a description of the new species and discusses the new genus.

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Sinogammarus n. gen.

Diagnosis

Body smooth. Urosomites with dorsal groups of spines and setae. Eyes absent. Accessory flagellum of antenna 1 pluriarticulate; flagellum of antenna 2 with calceoli in the male. Mouthparts *Gammarus* -like: article 3 of mandibular palp weakly falcate, with A, B, D, E setae, left and right maxillae 1 asymmetric, outer plate with ten or eleven poorly toothed spines. Coxae *Gammarus*-like. Gnathopods 1-2 in male large, scarcely dissimilar to each other: propodus large, suboval, elongate, bearing oblique palm with row of palmar spines. Gnathopods 1-2 in female more dissimilar to each other: propodus of gnathopod 1 suboval, with only one median palmar spine, propodus of gnathopod 2 subtrapezoidal, with almost parallel lateral margins, without median palmar spines. Pereopods 5-7 elongate, relatively slender, basis of pereopods 6-7 with distinct posterodistal rectangular lobe. Uropod 1 peduncle, with one or two basifacial spines. Uropod 2 with unequal rami. Rami of uropods 1-2 with very few spines. Uropod 3 magniramous, rami elongate, lanceolate, setose, outer ramus biarticulate, article 2 reduced or vestigial. Telson *Gammarus*-like. Coxal gills with peduncle, on pereonites 2-7. Oostegites moderately broad, with long marginal setae.

Type species of genus: *Sinogammarus troglodytes* n. sp.

Derivatio nominis. From the Latin name for China.

Discussion of affinities

The Gammaridae family (sensu Barnard & Barnard, 1983; 1990) includes a number of genera with microphthalmous or anophthalmous species inhabiting the subterranean water of southern Europe, especially the Caucasus region and the Balkan peninsula. However, to date this family has not included any representative of the subterranean waters of Asia, except for Anatolia. The European and Anatolian species belong partly to the *Echinogammarus-Sarothrogammarus*-group (e.g. *Rhipidogammarus, Tyrrhenogammarus,* which are basically Mediterranean) and partly to the *Gammarus*-group.

The genera in this latter group are *Typhlogammarus* Schäferna, 1907 (type species: *T. mrazeki* Schäferna, 1907), *Metohia* Absolon, 1927

(type species: *M. carinata* Absolon, 1927), *Zenkevitchia* Birstein, 1940 (type species: Z. *admirabilis* Birstein, 1940), *Anopogammarus* Derzhavin, 1945 (type species: *A. birsteini* Derzhavin, 1945), *Accubogammarus* G. Karaman, 1974 (type species: *Typhlogammarus algor* G. Karaman, 1973), and *Albanogammarus* Ruffo, 1995 (type species: *A. inguscioi* Ruffo, 1995).

Barnard and Barnard (1983) assign these genera, together with *Fontogammarus* S. Karaman, 1931, *Ilvanella* Vigna Taglianti, 1971, and *Tadzocrangonyx* G. Karaman & Barnard, 1979, to the «Metohiids» group, which we consider artificial, since phylogenetically different taxa are placed together (Ruffo, 1995).

In order to complete this survey, it must be noted that in the genus *Gammarus* Fabricius, 1775 (type species: *Cancer pulex* Linnaeus, 1758) there are various species, some of them microphthalmous and others anophthalmous, that populate the subterranean waters of Europe and Anatolia (G. Karaman, 1989). Some of these species belong to the *pulex*-group (sensu G. Karaman & Pinkster, 1977): *pulex polonensis* G. Karaman & Pinkster, 1977, *microps* Pinkster & Goedmakers, 1975, *vignai* Pinkster & G. Karaman, 1978; others belong to the *balcanicus*-group (sensu G. Karaman & Pinkster, 1987): *albimanus* G. Karaman & Pinkster, 1987, *sketi* G. Karaman, 1989.

Sinogammarus n. gen. is most certainly allied to the *Gammarus*-group. Among the genera in this group, *Sinogammarus* differs from *Zenkevitchia* and *Albanogammarus* in the number of spines of maxilla 1, which are ten or eleven in *Sinogammarus*, seventeen in *Albanogammarus*, and up to fifty in *Zenkevitchia*. Furhermore, in these last two genera the spines are recurved and finely pectinate, so that the maxillae seem to be modified (particularly in *Zenkevitchia*) to serve as a filter.

Sinogammarus is superficially similar to the balcanic genera *Typhlogammarus*, *Accubogammarus*, *Metohia*, but *Typhlogammarus* differs in the very different shape of the coxae, the nearly symmetric left and right palps of maxilla 1, the uniarticulate outer ramus of uropod 3 and shorter telson; *Accubogammarus* differs in the short, narrow and symmetric palps of maxilla 1, the partially reduced setae on the inner plate of maxilla 1, different shape of coxae 3-4, uniarticulate outer ramus of uropod 3 and shorter telson; *Metohia* differs in the carinate body, slightly produced epimeral plates, slightly different shape of the coxae and less elongate propodus of gnathopods 1-2 (both in males and females).

The two genera most closely allied to *Sinogammarus* are *Gammarus* and *Anopogammarus*. *Sinogammarus* differs from *Gammarus* only in the larger propodus of gnathopods 1-2, which are slightly dissimilar, in the male, and from *Anopogammarus* (compared only to the type species *A. birsteini*) in the longer inner ramus of uropod 3, the more vestigial article 2 of outer ramus, and the oostegites with normally long marginal setae.

Unfortunately, the description of both species of the genus *Anopogammarus* is quite incomplete (Derzhavin, 1945; Birstein & Levushkin, 1970; cfr. also Barnard & Barnard, 1983); many taxonomical characters have yet to be described, especially those of the female, and consequently cannot be used for comparison. Therefore, we cannot exclude the possibility that *Sinogammarus* is synonymous with *Anopogammarus*, but at present we do not know of any transitional taxa with characters regarding the length of the inner ramus of uropod 3.

On the other hand, the subterranean genera of Gammaridae are relatively similar to one another, and some of them are poorly described. Thus, it is difficult to make a comparison and careful analysis of the status of *Sinogammarus* within the family.

Sinogammarus troglodytes n. sp.
(Figs. 1-6)

Material examined

China: Liujia Cave, Sichuan prov., near Huaying, 810 m a.s.l., August 12, 1993, 1 ♂ 2 ♀♀ 1 juv. (leg. Jolanda Galletti).

China: Diuren Cave, Sichuan prov., near Huaying, 740 m a.s.l., August 14, 1993, 2 ♀♀ juv. (leg. Jolanda Galletti).

The holotype from Liujia Cave (♂ 25 mm MVR Cr 362), dissected and partially mounted in Faure's medium, on slides nr. 3841-3842, have been deposited, with the paratypes, in the Museo Civico di Storia Naturale, Verona.

Description

Male, 25 mm long. Body robust, without pigment. Epimeral plates 1-2 (Fig. 4b) with marked posteroventral corner and convex posterior margin; epimeral plate 3 with slightly pointed posteroven-

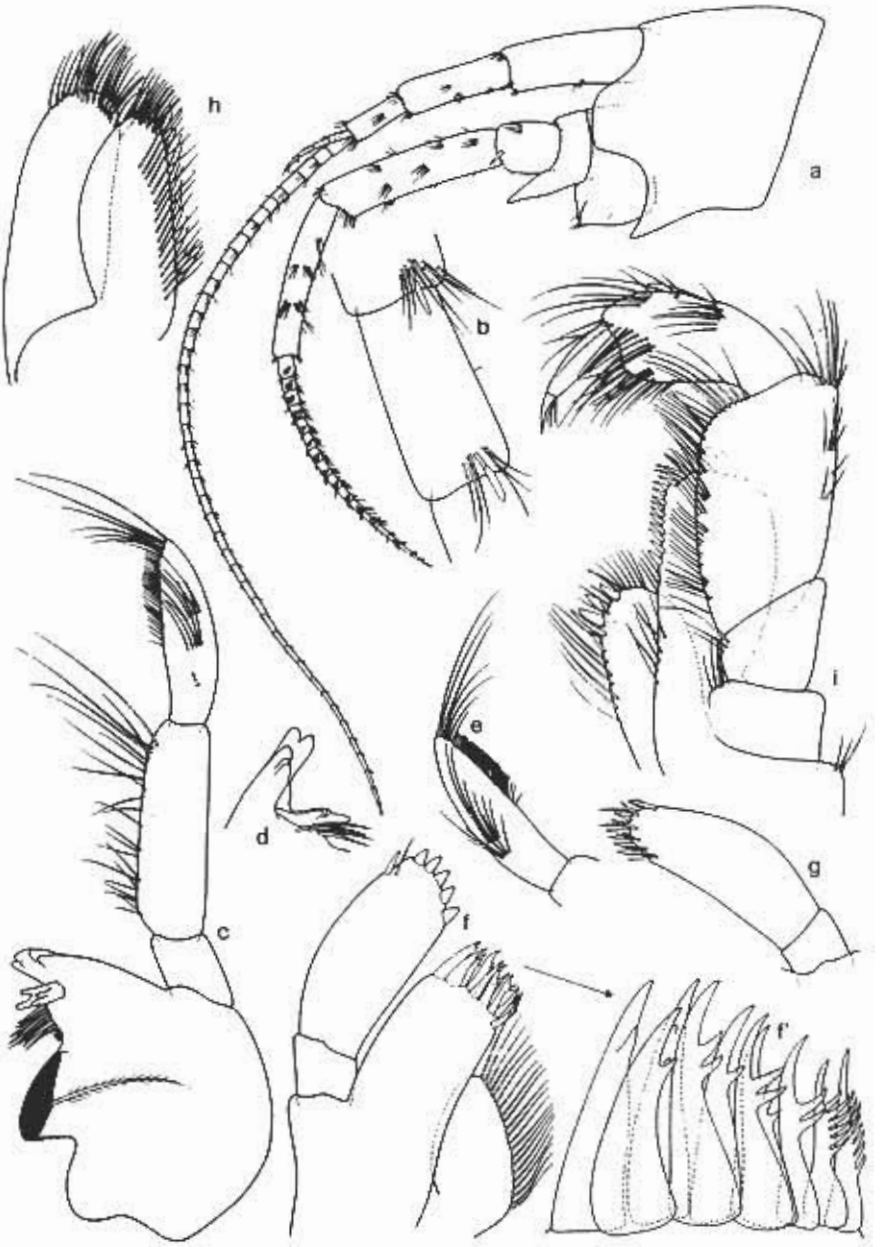

Fig. 1 — *Sinogammarus troglodytes* n. gen. n. sp., ♂ holotype 25 mm, Liujia Cave, Sichuan prov. (China). a, head and antennae 1-2; b, flagellum article 4 of antenna 1; c, right mandible; d, incisor and lacinia mobilis of left mandible; e, mandibular palp article 3 on outer face; f, f', right maxilla 1; g, palp of left maxilla 1; h, maxilla 2; i, maxilliped.

tral corner and poorly concave posterior margin; epimeral plates 2-3 with several spines on ventral margin. Urosomites 1-3 (Fig. 4c) relatively low, dorsally poorly elevated, with groups of spines and setae according to following formula (number of setae in parenthesis):

1 (6) 1 (7) 1 (6) 1 (6)
1 (7) 1 (5) 1 (6) 1 (6)
1 (7) 0 (7) 1 (3)

Urosomite 1 with one small ventral spine near basis of peduncle of uropod 1.

Head (Fig. 1a) with subquadrate lateral lobes and well developed, deep sinus; rostrum short, eyes absent.

Antenna 1 (Fig. 1a) reaching half of body, peduncular articles 1-3 ratio = 1:0.7:0.4; main flagellum with about forty three articles (most articles with one short aesthetasc each (Fig. 1b), accessory flagellum longer than peduncle article 3, with five articles. Antenna 2 (Fig. 1a) shorter than antenna 1, relatively strong, gland cone hardly exceeding tip of peduncular article 3, peduncular article 5 slightly shorter than article 4, with low number of short setae, flagellum slender, with about sixteen articles, bearing low number of short setae and one calceolus each.

Labium subrounded, broader than long. Mandibles strong, with strong triturative molar (Fig. 1c); left mandible with incisor bearing five teeth (Fig. 1d); right mandible molar with one long distal seta, incisor with four teeth, lacinia mobilis bifurcate, pluritoothed (Fig. 1c); mandibular palp triarticulate, strong, article 1 short and smooth, article 2 with about twenty three setae, article 3 slightly shorter than article 2, with two groups of A-setae on outer face, two groups of B-setae on inner face, about thirty D-setae and seven E-setae (Fig. 1c, e). Labium without inner lobes, outer lobes entire. Left and right maxillae 1 asymmetric, but both with triangular inner plate (Fig. 1f, f'), bearing distolateral row of plumose setae and outer plate with then or eleven poorly toothed spines (formula of teeth, from inner to outer margin: 8-6-2-3-2-1-2-2-1-1 or 9-5-5-4-3-3-1-2-2-1-2); palp of left maxilla 1 (Fig. 1g) narrowed, with seven + one slender spines and four setae, palp of right maxilla 1 (Fig. 1f) broader, with five + one strong spines and one seta. Maxilla 2 (Fig. 1h): both plates narrow, with numerous distal setae, inner plate with diagonal row of plumose facial setae and row of setae on inner margin. Maxil-

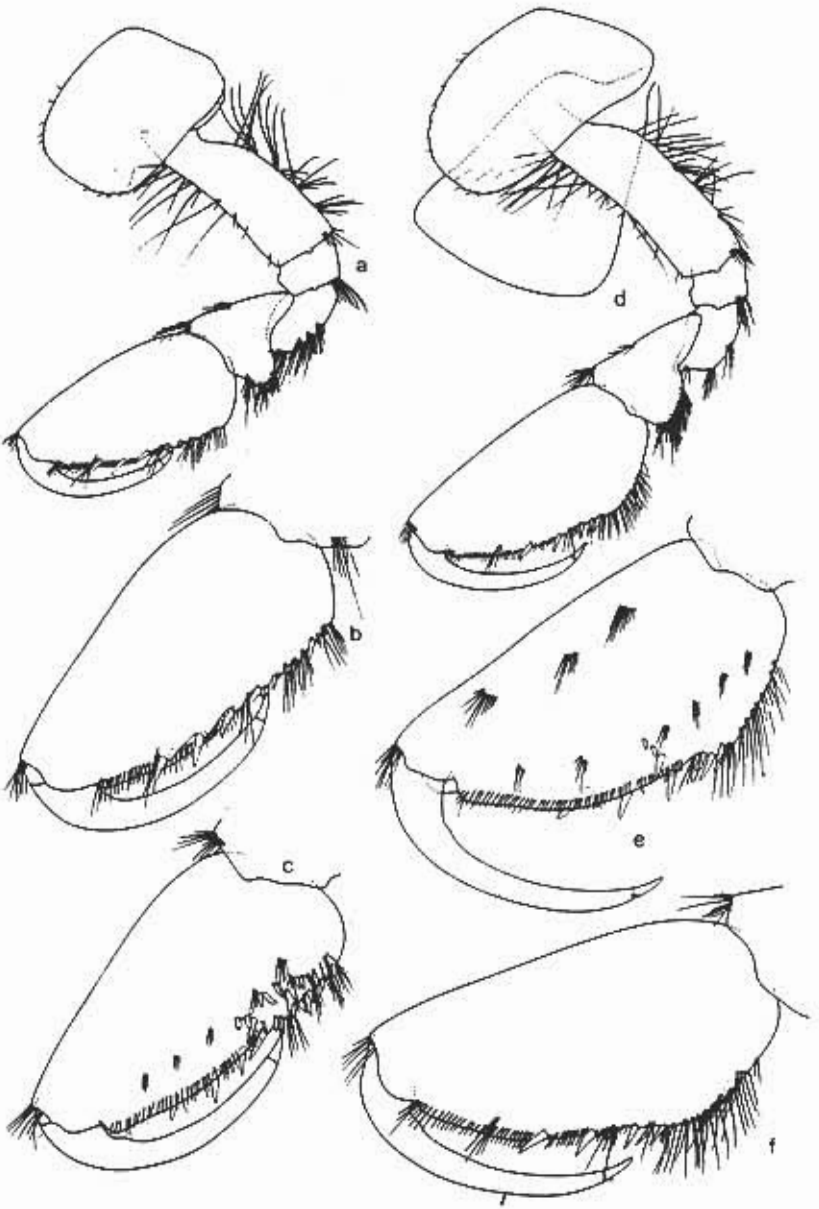

Fig. 2 — *Sinogammarus troglodytes* n. gen. n. sp., ♂ holotype 25 mm, Liujia cave, Sichuan prov. (China). a, gnathopod 1; b, c, propodus of gnathopod 1 on outer and inner face; d, gnathopod 2; e, f, propodus of gnathopod 2 on inner and outer face.

liped (Fig. 1i): inner plate short, with three distal and one subdistal spine and numerous setae, outer plate slightly exceeding half of palp article 2, with row of smooth distolateral spines, palpus quadriarticulate, nail markedly shorter than pedestal.

Coxae 1-4 (Figs. 2a, d; 3a; 4a) longer than broad, with short marginal setae; coxa 4 with well developed posteroventral lobe; coxae 5-6 (Fig. 3b, c) with anterior lobe much shorter than posterior one, coxa 7 (Fig. 3d) bilobed, incised nearly in middle.

Gnathopod 1 (Fig. 2a): basis with numerous long setae along both margins, merus with transverse rows of posterior setae, carpus short, triangular, propodus large (Fig. 2b), nearly twice as long as broad, ovate-elongate, tapering distally, palm very oblique and poorly defined from posterior margin, bearing a row of four strong palmar spines, posterior margin below the palm with several spines accompanied by groups of setae and with several facial spines on inner face (Fig. 2c); dactylus long, exceeding half of posterior margin, without setae along outer and inner margins. Gnathopod 2 (Fig. 2d) similar to gnathopod 1: merus with two groups of setae along posterior margin, carpus short, triangular, propodus ovate-elongate, nearly twice as long as broad, with convex palm slightly exceeding half of posterior margin, bearing a row of three median palmar spines and defined by group of corner spines; about ten groups of setae along posterior margin, below the corner spines of the palm, inner face of propodus with several facial setae (Fig. 3e); dactylus slightly exceeding half of propodus, without setae on inner and outer margins.

Pereopods 3-4 (Figs. 3a; 4a): basis with numerous long setae along both margins; merus, carpus and propodus with groups of short setae often accompanied by single or paired short spines, dactylus short and stout, nail much shorter than pedestal, with one short strong seta at inner margin.

Pereopod 5 (Fig. 3b): basis subrectangular, posterior margin nearly straight, with about fifteen weak indentations and rounded posteroventral lobe. Pereopods 6-7 slender (Fig. 3c, d); basis elongate, posterior margin proximally convex, distally narrowed, with about eighteen indentations, with well developed rectangular posteroventral lobe and one spine and two setae on inner face of the submarginal posteroventral portion; merus, carpus and propodus bearing short spines along both margins, accompanied by single short seta; dactyli short (Fig. 3d'), with short spine-like seta at inner

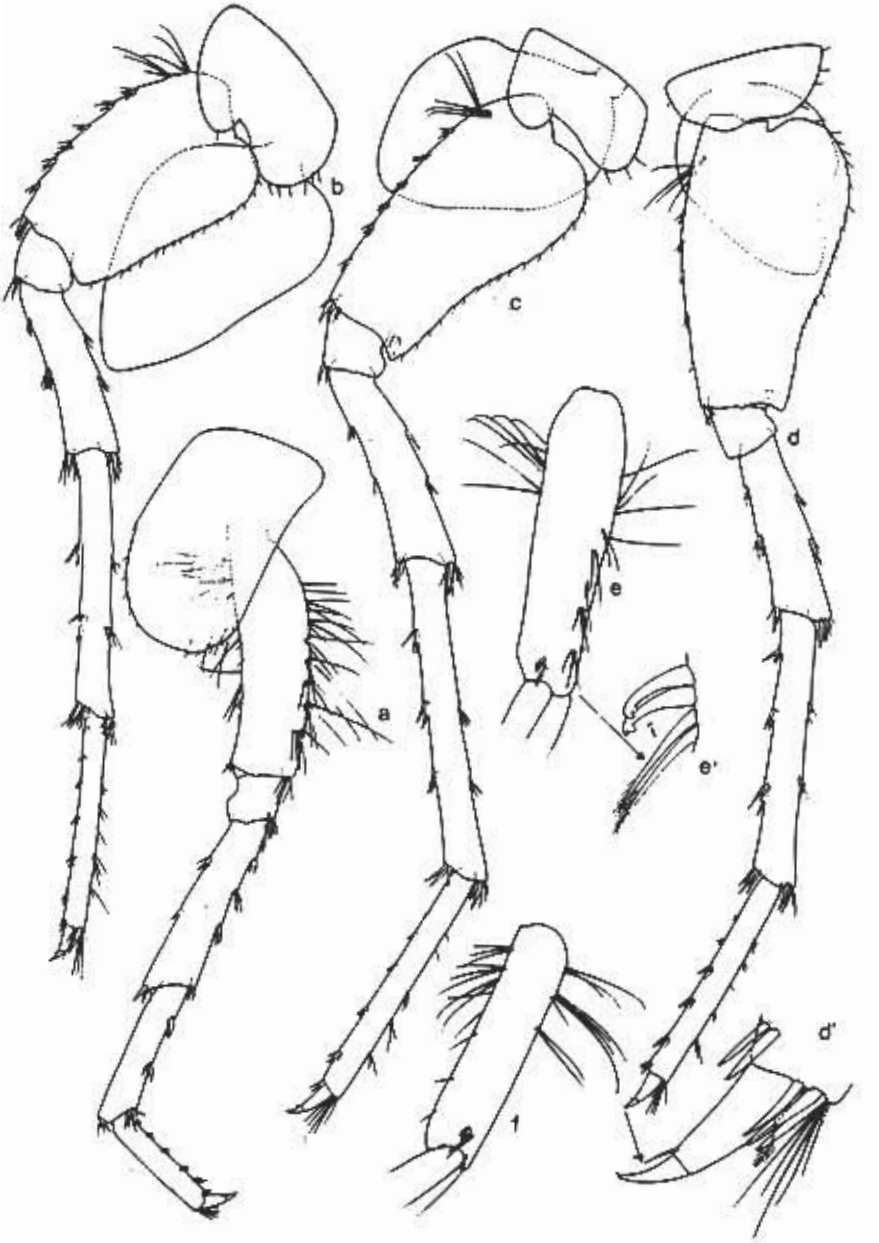

Fig. 3 — *Sinogammarus troglodytes* n. gen. n. sp., ♂ holotype 25 mm, Liujia cave, Sichuan prov. (China). a, pereopod 3; b, c, d, d', pereopods 5-7; e, e', peduncle of pleopod 1; f, peduncle of pleopod 3.

margin and one short plumose seta at outer margin, nail much shorter than pedestal.

Pleopods 1-3 normal, peduncle (Fig. 3e, e', f) with numerous long setae in proximal portion and two retinacula accompanied by two long setae.

Uropod 1 (Fig. 4c): peduncle longer than rami, with two basifacial spines and dorsoexternal row of spines, dorsointernal row of spines absent, inner ramus slightly longer than outer one, with only one marginal median spine, outer ramus with only one proximal spine. Uropod 2 (Fig. 4c): inner ramus markedly longer than outer one, with 2 marginal spines, outer ramus with only one median spine. Uropod 3 distinctly exceeding tip of uropods 1-2 (Fig. 4c, e): rami lanceolate, bearing long plumose setae along both margins, sometimes accompanied by single spines, outer ramus biarticulate, article 2 vestigial, shorter than adjacent spines and provided with distal setae (Fig. 4e'), inner ramus exceeding 4/5 of outer ramus.

Telson longer than broad (Fig. 4d), incised nearly to the basis, each lobe with two-three distal spines accompanied by several setae longer than the spines themselves and with several groups of setae on dorsal face of the lobes.

Female, 18.2 mm long. Dorsal groups of spines and setae of urosomites 1-3 according to the following formula (number of setae in parenthesis):

1(7)	1(8)	1(9)	2(8)
3(7)	1(7)	1(7)	2(5)
2(6)	0(5)	0(5)	2(6)

Antenna 1 slightly exceeding half of body, main flagellum with about thirty-two articles, usually bearing one short aesthetasc. Antenna 2: gland cone strongly exceeding tip of peduncular article 3, peduncle and flagellum with poorly long setae, flagellum with about fourteen articles, calceoli absent.

Maxilla 1: number of teeth on spines of outer plate, from inner to outer margin: 10-5-4-5-2-5-2-3-2-1-1 or 10-7-6-5-5-5-3-3-1-1.

Coxae 1-4 like those of male, but slightly longer (Figs. 5b; 6a).

Gnathopods 1-2 slightly smaller than those of the male. Gnathopod 1: merus with three groups of setae along posterior margin, carpus short, triangular, propodus subpyriform (Fig. 5a), almost twice as long as broad, palm convex, with only one median palmar spine, defined by groups of corner and subcorner spines (Fig. 5a'), dactylus

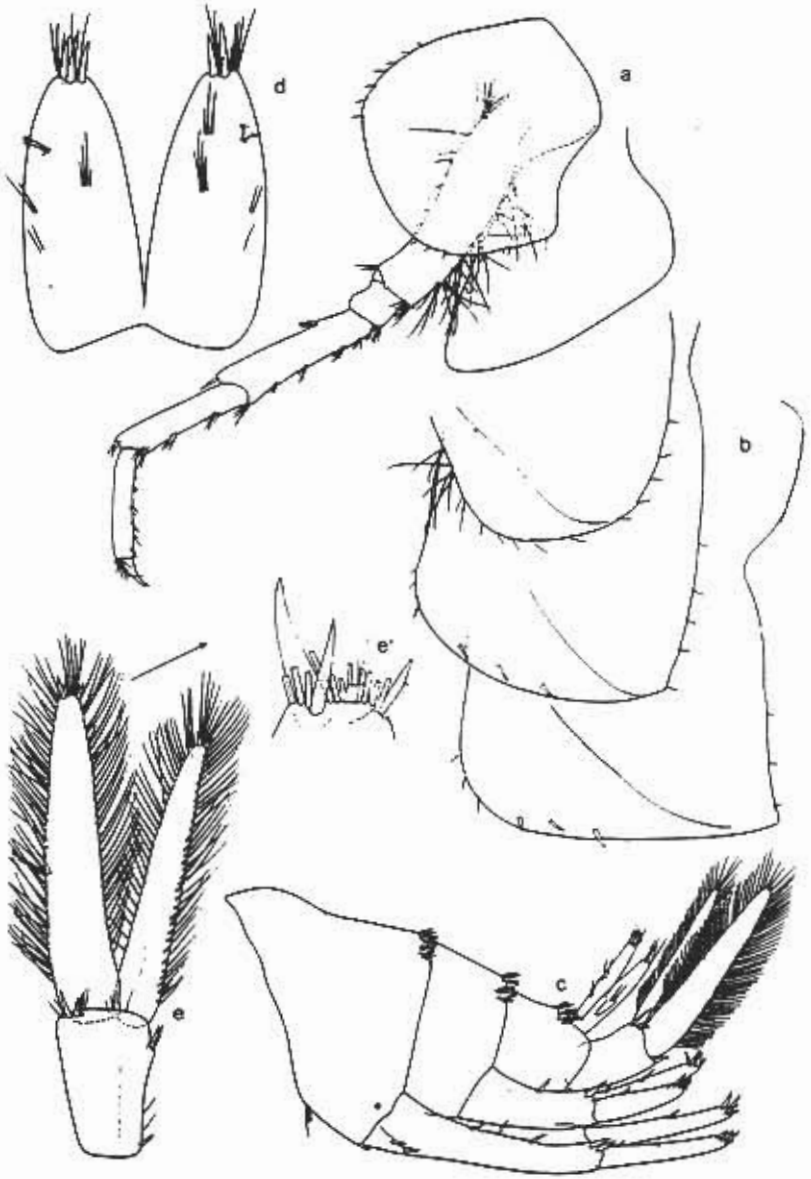

Fig. 4 — *Sinogammarus troglodytes* n. gen. n. sp., ♂ holotype 25 mm, Liujia cave, Sichuan prov. (China). a, pereopod 4; b, epimeral plates 1-3; c, urosome; d, telson; e,e' uropod 3.

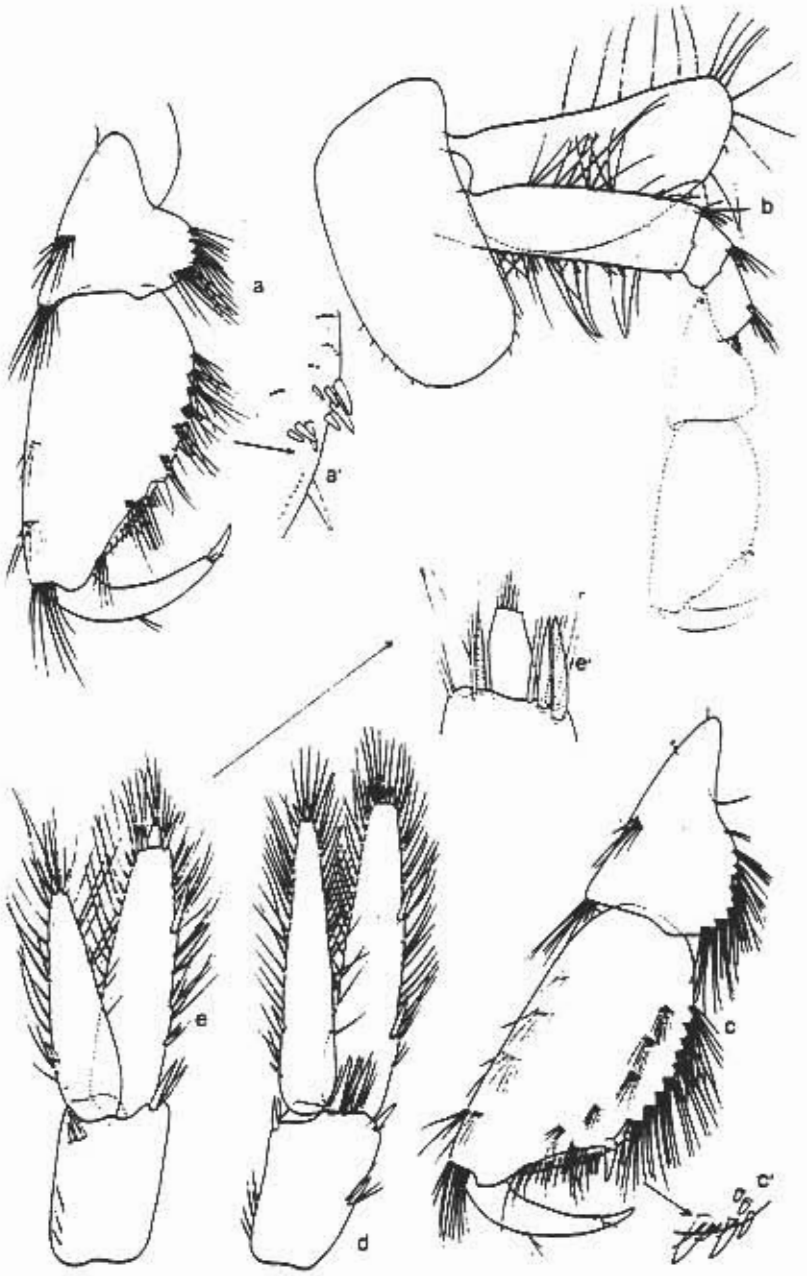

Fig. 5 — *Sinogammarus troglodytes* n. gen. n. sp., ♀ paratype 18.2 mm, Liujia cave, Sichuan prov. (China). a, a', propodus of gnathopod 1; b, gnathopod 2; c, c', propodus of gnathopod 2; d, uropod 3. ♀ juv. 12 mm, Diuren cave, Sichuan prov. (China). e, e', uropod 3.

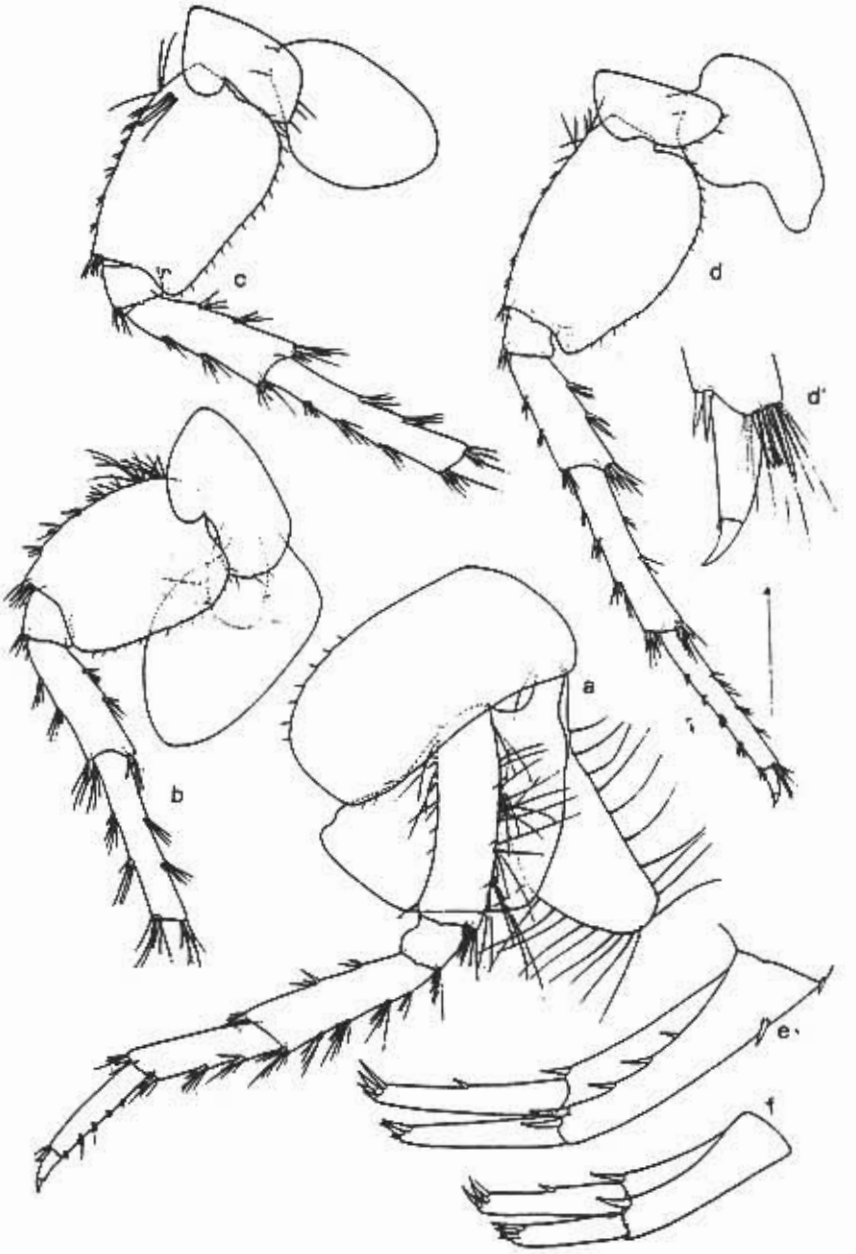

Fig. 6 — *Sinogammarus troglodytes* n. gen. n. sp., ♀ paratype 18.2 mm, Liujia cave, Sichuan prov. (China). a, pereopod 3; b, c, d, d', pereopods 5-7; e, f, uropods 1-2.

slightly shorter than that of male, with one median pair of setae at outer margin. Gnathopod 2 (Fig. 5b): merus with two groups of setae at posterior margin, carpus short and triangular, propodus (Fig. 5c) slightly less than twice as long as broad, with almost parallel lateral margins and nine posterior marginal groups of setae; palm oblique but relatively short, without median palmar spine, with three marginal spines near palmar corner and two short subcorner spines on inner face (Fig. 5c'), dactylus relatively short, with one pair of median setae along outer margin.

Pereopods 3-4 (Fig. 6a) like those of the male but with longer setae along posterior margin.

Pereopods 5-7 (Fig. 6b, c, d) slightly shorter and broader than those of male, especially the basis; merus, carpus and propodus with higher number of lateral setae than those of male.

Uropod 1 (Fig. 6e): peduncle with one basifacial spine, inner ramus distinctly longer than outer one, bearing one median and several distal short spines, outer ramus with distal spines only. Uropod 2 (Fig. 6f): inner ramus markedly longer than outer one, with one median and several short distal spines, outer ramus with distal spines only. Uropod 3 and telson like those of male.

Variability

The old spines of outer plate of maxilla 1, with more or less worn-out lateral teeth, have a lower number of lateral teeth than the new spines of the same maxilla (for example, the left maxilla of the female, 18.2 mm long, in the worn-out stage have the following formula of the lateral teeth: 8-6-5-3-4-2-?-2-1-1-1; the new spines of the same maxilla 1 have the following formula: 10-7-6-5-5-5-5-3-3-1-1). Peduncle of uropod 1 with one or two basifacial spines.

The juv. females of up to 12 mm from Diuren Cave agree with the specimens from the Liujia Cave, but article 2 of the outer ramus of uropod 3 can be slightly vestigial or slightly longer on the same specimen, while still being shorter than the spines around it (Fig. 5e, e'). Lobes of the telson with three distal spines each. Gnathopods 1-2 with palm of propodus much more similar to those of the genus *Gammarus*. Epimeral plates 2-3 with ventral spines only, ventromarginal spines absent.

ACKNOWLEDGEMENTS

We wish to express our warmest thanks to Dr. Jolanda Galletti of the Centro Ibleo di Ricerche speleo-idrologiche in Ragusa (Sicily) for having allowed us to study the interesting troglobiont Gammarid she found during the 1993 speleological campaign in China.

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