

FIGURE 12. *Stammericaris destillans* sp. nov.: A, female, P4, P5, genital field with attached spermatophore, ventral view; B, female, caudal ramus, outer view. *Stammericaris trinacriae* (Pesce, Galassi and Cottarelli 1988), male: C, habitus, lateral view; D, cephalothorax and first two pedigerous somites, antennule, antenna, P1, P2, lateral view. E, basis P1, inner view; F, P3, inner view.

P6 (Fig. 7K): vestigial, fused into simple cuticular plate, unornamented and unarmed.

Female. Body length, excluding caudal setae, from 363 to 446 μ m, mean 391 μ m ($n = 6$); length of specimen in Fig. 1B: 454 μ m. Habitus as in Fig. 13C, ornamentation of somites, pigmentation, and lack of nauplius eye as in male, except genital and first urosomite fused into double-somite. Prosome/urosome ratio: 0.71. Genital double-somite (Fig. 8A) without any trace of subdivision, longer than previous and following somites. Genital field (Figs. 8A, 14D) broader than tall, occupying anterior ventral half of genital double-somite; single genital aperture covered by fused vestigial sixth legs; median copulatory pore located medially at 1/3 of double-somite length. Anal somite and anal operculum as in male (Fig. 14E).

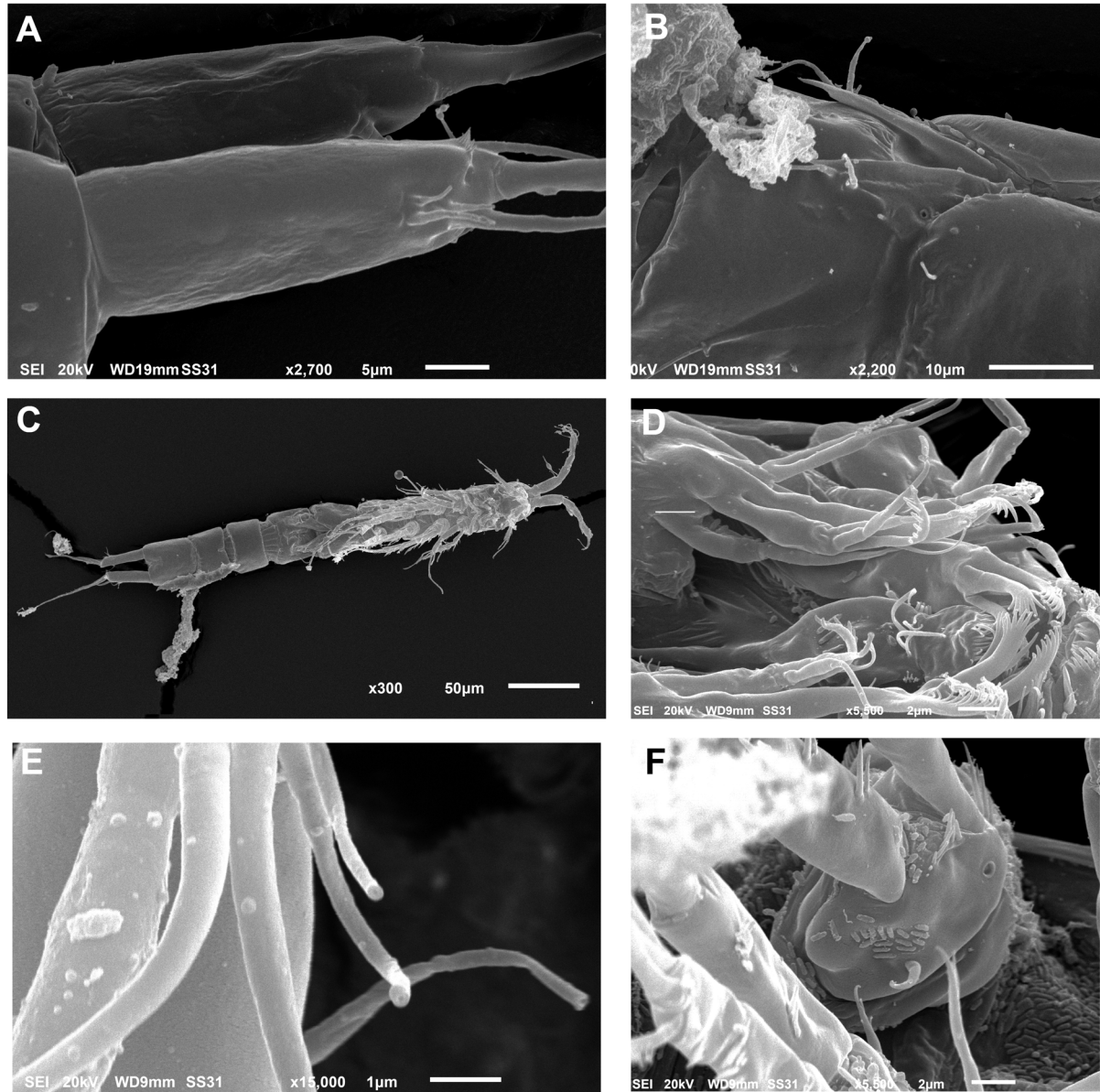


FIGURE 13. *Stammericaris trinacriae* (Pesce, Galassi and Cottarelli 1988): A, male, caudal rami, lateral view; B, male, P5. C, female, habitus, ventral view; D, female, mouth parts, ventral view.; E, A1, transformed setae on fifth segment; F, female, basis P1, anterior view.

Caudal rami (Figs. 8B, 14F) shape similar to those of male but shorter, length/width ratio: 4.7. Ornamentation and armature similar to those in male but setae IV to VI proportionally shorter and seta VII proportionally longer; length seta IV/length caudal ramus: 0.54; length seta VI/length caudal ramus: 0.37, length seta VII/length caudal ramus: 0.49.

Rostrum, antenna, oral appendages (Fig. 13D), maxilliped as in male.

Antennule (Fig. 8D): seven-segmented, aesthetasc on fourth segment shorter than in male, reaching below end of seventh segment. First segment bare. Second segment longest. Apical acrothek represented by two setae of different length and slender aesthetasc, almost as long as aesthetasc on segment four. Armature formula: 1-[0], 2-[1 pinnate + 3 bare], 3-[5bare], 4-[2 + ae], 5-[1], 6-[1], 7-[7 bare + (2 + ae)]. Several setae transformed, ending in a small hollow disk (Fig. 13E).

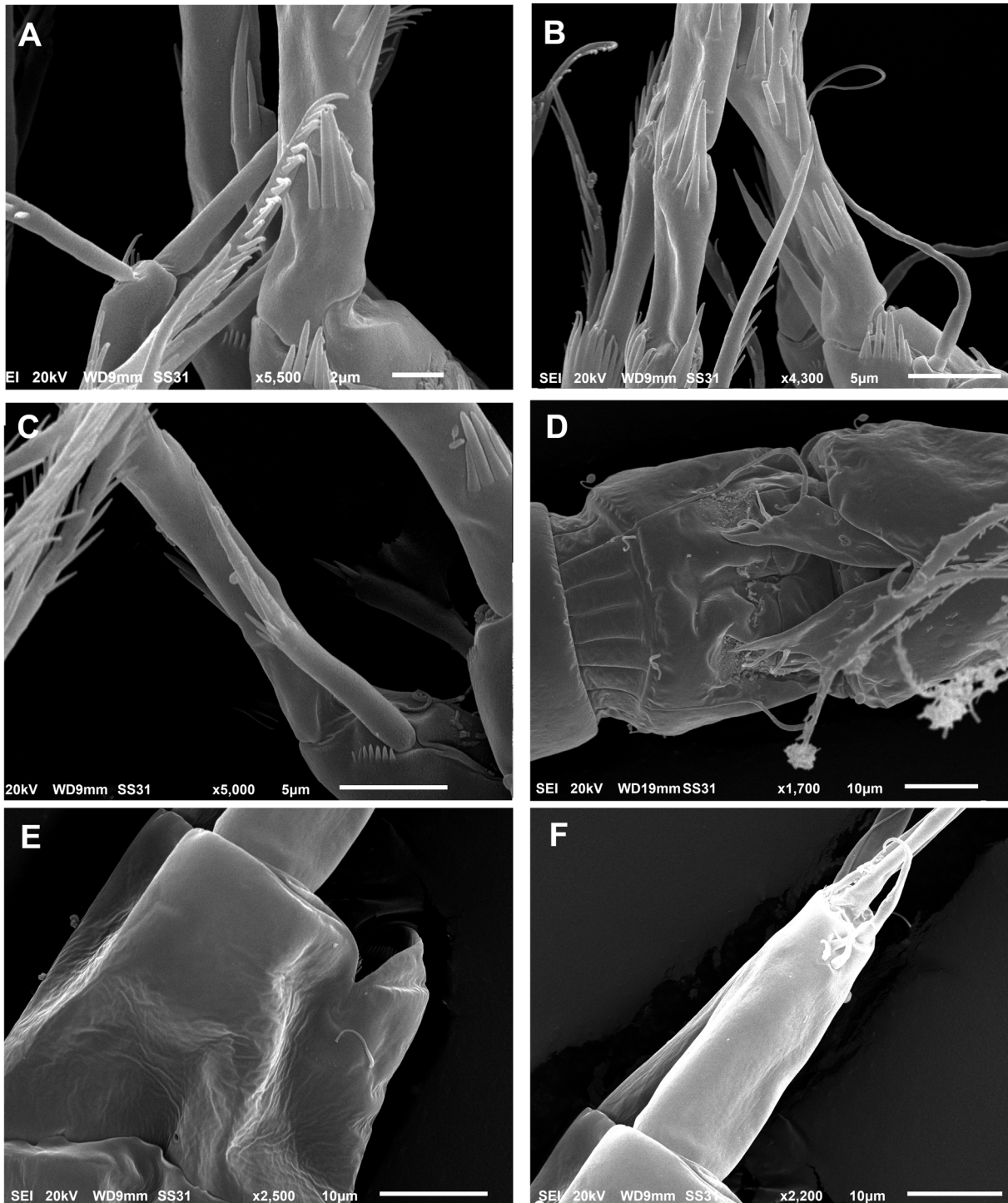


FIGURE 14. *Stammericaris trinacriae* (Pesce, Galassi and Cottarelli 1988), female: A, P2 endopod, lateral view; B, P3 endopod, lateral view; C, P4 endopod, lateral view; D, P5 and genital field; E, anal somite and anal operculum, lateral view; F, caudal rami, lateral view.

P1 (Figs. 8E, 13F): basis, ornamentation and armature as in male except with inner curved seta apically transformed, and pore near outer seta insertion; endopod and exopod similar in shape to the male, but endopod slightly longer than exopod.

P2 (Figs. 8F, 14A): coxa and basis as in male with spinular row on ventral side, near endopod insertion.

Ornamentation and armature of exopod as in male. Endopod similar in shape and ornamentation to that of the male, apical seta proportionally longer.

P3 (Figs. 9A, 14B): intercoxal sclerite taller than wide, with concave margin, smooth. Basis with outer seta and spinular row, and spinular row on ventral side, near endopod insertion (Fig. 14B); exopod two-segmented, segments of same length. Exp-1 ornamented with spinular row along outer margin, with distolateral pinnate spine; exp-2 with subapical outer pinnate spine and apical pinnate seta. Endopod (Fig. 14B) represented by a thin and pointed segment, with spinules along margin, 0.8 times as long as corresponding exp-1.

P4 (Figs. 9B, 14C): intercoxal sclerite, coxa, exopod as in male. Basis with spinular row on ventral side, near endopod insertion. Endopod represented by a thin cylindrical segment, ending in a pointed tip, pinnate in the distal half, slightly shorter than the corresponding exp-1.

P5 (Figs. 8A, 14D): fused to intercoxal sclerite, represented by two cuticular plates much longer and narrower than in the male, with proximal large pore and inner-distal corner produced into long and strong pointed tip. Armature on free distal margin, from inner to outer: three bare setae of different length, outermost shortest.

P6 (Fig. 8A): vestigial, fused into simple cuticular plate, covering gonopore, unornamented and unarmed.

Variability. Two females with transformed caudal rami (Fig. 8C): length/width ratio: ~3; armature modified as follows: seta I, II, III subequal and very short, seta IV transformed in a hooked spine, seta V massive, conical, and distally pinnate; setae VI and VII shortened.

Amended diagnosis of the genus *Stammericaris* Jakobi, 1972. Male antennule 8-segmented and of the pocket-knife type. Basis P1 male with hook, with hook and seta, without armature (but see note below) near endopod insertion. Basis P1 female with small seta or without armature (but see note below). Endopod P3 female half as long as or shorter than first segment of corresponding exopod. Outer margin of P3 male exp-1 proximally and distally with group of several spinules, or spinules only proximally (in one case) or without spinules (one case); apophysis long with a rounded tip and slightly curved inwards, being twice as long as the thumb or even longer. Male P4 basis with an inner row of 1-4 curved spinules decreasing in size laterally; P4 male endopod a curved plate with a pointed inner tip carrying at its outer border two outgrowths, in most cases the distal one is a feathered or plain seta. Caudal rami cylindrical almost as long as anal somite, group of lateral setae located at end of rami.

Note: in all recently-described species the P1 basis of males and females is medially armed; it is very likely that this character was not noted in early descriptions.

Molecular results

The partial COI fragment was amplified for 55 specimens of Parastenocarididae, and the partial 18S fragment for 19 specimens of Parastenocarididae; 11 COI haplotypes and nine 18S haplotypes were generated and submitted to the National Center for Biotechnology Information (NCBI) GenBank database (www.ncbi.nlm.nih.gov; accession numbers listed in Table 1). For the COI gene, the genetic distance between *P. amalasuntae* and the *Stammericaris* species used in our analysis varied between 23.5% and 25.2% (Table 2). Within the genus *Stammericaris*, the genetic distance between species ranged from 14.5% to 22.9%. Genetic distances between the haplotypes of *S. trinacriae* were even lower (4.8%; Table 2). The genetic distances for the 18S fragment were lower with respect to COI but showed the same pattern (Table 2).

The ML and BI multi-gene phylogenetic trees (Fig. 15) had high node support values and showed the same topology. *Proserpinicaris amalasuntae* was clearly distinct from the species of *Stammericaris* studied here (node support 0.99 for ML and 1.00 for BI). Within the genus *Stammericaris*, two other highly supported clusters were evident (0.97 for ML, 1.00 for BI): *S. diversitatis* and *S. trinacriae*, and *S. destillans* and *S. pasquinii*, respectively. However, while the cluster of *S. diversitatis* and *S. trinacriae* was well-supported (0.98 for ML and 1.00 for BI), the cluster of *S. destillans* and *S. pasquinii* was weakly supported (0.75 for ML and 0.82 for BI).

TABLE 1. List of Parastenocarididae species used for phylogenetic analysis, including collection site, habitat and date, number of specimens for which DNA was successfully extracted and amplified for the two investigated fragments (COI and 18S), number of haplotypes recorded for each species/fragment, and GenBank accession numbers for nucleotide sequences generated by us. Collection method: DF= drip funnel (after Brancej 2003); RP = rimstone pool (after Brancej 2003); KC = Karaman-Chappuis method (Delamare-Deboutteville 1960).

Species	Collection site	Habitat (collection site typology)	Collection date	COI: N ind./ haplotypes (names) sequenced, GenBank acc. Numbers	18S: N ind./ haplotypes sequenced, GenBank acc. numbers
<i>Bereraria</i> sp.	Belice River (Porto Palo, Agrigento, Sicily)	Interstitial, hyporheic (left bank, rivermouth)	2/Mar/2014 (KC)	3/3 (a, b, c) Haplo_a: MF462061 Haplo_b: MF462062 Haplo_c: MF462063	2/1 MF462052
<i>Bryocampptus stillae</i>	Conza Cave (Palermo, Sicily)	Epikarstic (rimstone pool)	31/Jan/2014 (RP)	2/1 MF462064	2/1 MF462053
<i>Stammericaris diversitatis</i>	Conza Cave (Palermo, Sicily)	Epikarstic (1 drip)	4/Jan/2014 (DF)	2/1 MF462067	2/1 MF462057
<i>Stammericaris trinacriae</i>	Entella Cave (Palermo, Sicily)	Epikarstic (4 rimstone pools)	1/Mar/2014, 5/Apr/2014 (RP)	11/3 (a, b, c) Haplo_a: MF462069 Haplo_b: MF462070 Haplo_c: MF462071	2/2 (a,b) haplo_a: MF462059 haplo_b: MF462060
<i>Stammericaris destillans</i> sp. nov.	Molara Cave (Palermo, Sicily)	Epikarstic (3 rimstone pools; 1 drip)	2/Sep/2013, 12/Apr/2013 (RP, DF)	14/1 MF462066	2/1 MF462056
<i>Stammericaris pasquinii</i>	Bolsena Lake (Viterbo, Latium)	Interstitial, mesopsammal (lake shore)	1/Aug/2014, 27/Nov/2014 (KC)	12/1 MF462068	3/1 MF462058
<i>Proserpinicaris amalasuntae</i>	Bolsena Lake (Viterbo, Latium)	Interstitial, mesopsammal (lake shore)	1/Aug/2014, 27/Nov/2014 (KC)	11/1 MF462065	6/2 (a,b) haplo_a: MF462054 haplo_b: MF462055
Total				55/11	19/9

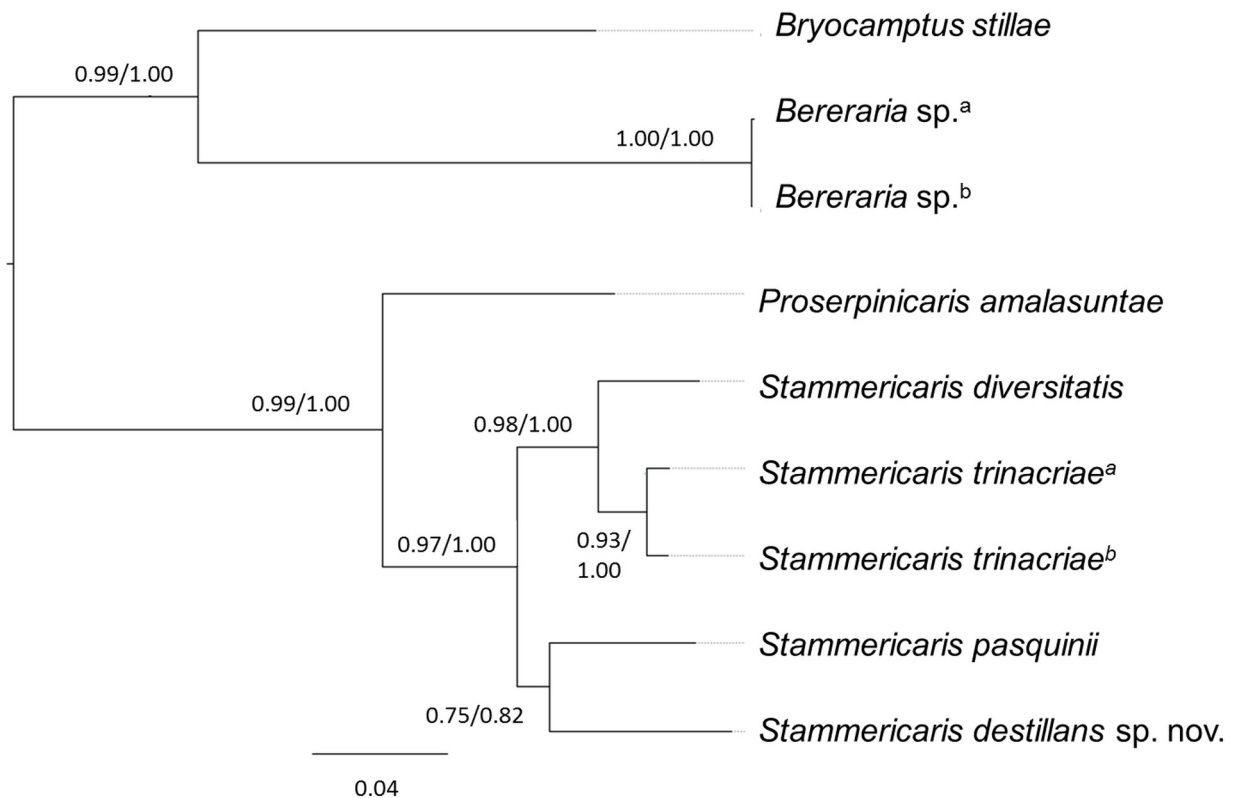


FIGURE 15. Phylogenetic tree of the Italian Parastenocarididae studied here with the outgroups *Bereraria* sp. and *Bryocamptus (Rheocamptus) stillae* Cottarelli and Bruno 2012, using a multi-gene approach (623 bp COI + 1756 bp 18S). COI and 18S haplotypes from the same individual specimen were combined as follows (^a and ^b refer to haplotypes; see Table 1): *Bereraria* sp. A = *Bereraria* sp. COI^a+18S^a; *Bereraria* sp. B = *Bereraria* sp. COI^b+18S^a; *P. amalasuntae* = *P. amalasuntae* COI^a+18S^b; *S. trinacriae* A = *S. trinacriae* COI^a+18S^b; *S. trinacriae* B = *S. trinacriae* COI^b+18S^a; all others are: COI^a+18S^a. Node support values from the approximate likelihood ratio test of the maximum likelihood and posterior probabilities of the Bayesian reconstruction are shown below or above each branch/node, respectively.

TABLE 2. Raw genetic distances between 18S and COI haplotypes of five Italian Parastenocarididae species; the superscript letters a, b, c, refer to different haplotypes (see Table 1).

18S	<i>P. amalasuntae^a</i>	<i>P. amalasuntae^b</i>	<i>S. destillans</i>	<i>S. diversitatis</i>	<i>S. pasquini</i>	<i>S. trinacriae^a</i>
<i>P. amalasuntae^b</i>	0.003					
<i>S. destillans</i>	0.019	0.017				
<i>S. diversitatis</i>	0.018	0.015	0.006			
<i>S. pasquini</i>	0.018	0.016	0.005	0.002		
<i>S. trinacriae^a</i>	0.018	0.015	0.006	0.001	0.001	
<i>S. trinacriae^b</i>	0.018	0.015	0.006	0.001	0.001	0.001
COI	<i>P. amalasuntae</i>	<i>S. destillans</i>	<i>S. diversitatis</i>	<i>S. pasquini</i>	<i>S. trinacriae^a</i>	<i>S. trinacriae^b</i>
<i>S. destillans</i>	0.235					
<i>S. diversitatis</i>	0.237	0.221				
<i>S. pasquini</i>	0.241	0.225	0.229			
<i>S. trinacriae^a</i>	0.252	0.205	0.147	0.219		
<i>S. trinacriae^b</i>	0.252	0.213	0.145	0.203	0.048	
<i>S. trinacriae^c</i>	0.250	0.213	0.147	0.201	0.048	0.004

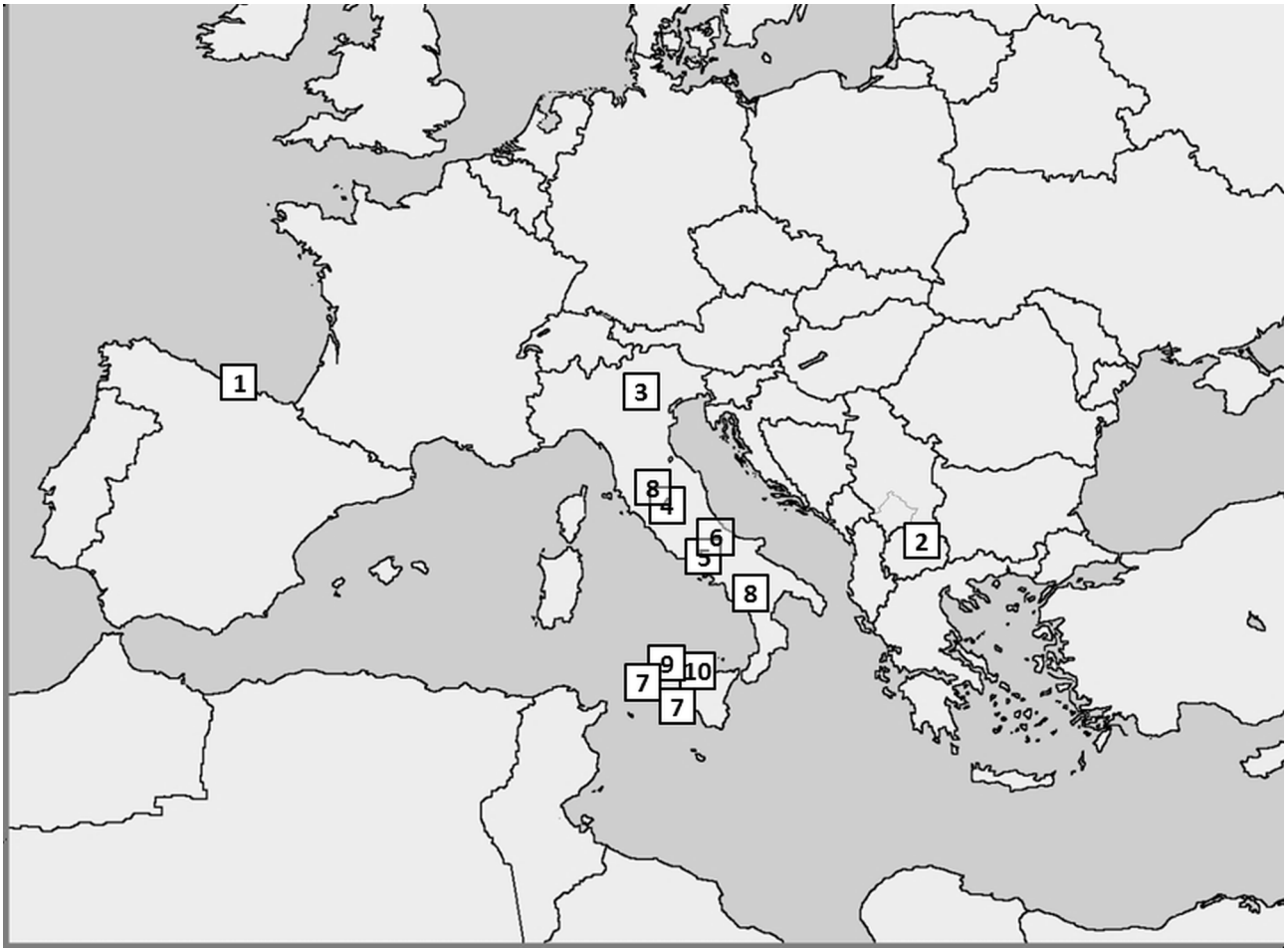


FIGURE 16. Distribution of the genus *Stammericaris* in Europe (modified from Schminke, 2010). 1: *Stammericaris stammeri* (Chappuis 1937); 2: *Stammericaris phreatica* (Chappuis 1936); 3: *Stammericaris acherusia* (Noodt 1955); 4: *Stammericaris pasquini* (Cottarelli 1972); 5: *Stammericaris amyclaea* (Cottarelli 1969); 6: *Stammericaris lorenzae* (Pesce, Galassi and Cottarelli 1995); 7: *Stammericaris trinacriae* (Pesce, Galassi and Cottarelli 1988); 8: *Stammericaris orcina* (Chappuis 1938); 9: *Stammericaris diversitatis* (Cottarelli and Bruno 2012); 10: *Stammericaris destillans* **sp. nov.** For details of distribution in Sicily, see Figure 1.

Discussion

Taxonomic definition of a new species of Parastenocarididae. The results from both the molecular and morphological analysis support the attribution of the new species from the Molara Cave to *Stammericaris*, although requiring a slight amendment to the diagnosis of the genus.

Stammericaris destillans **sp. nov.** can be easily distinguished from all the congeners by the male P4 which has a reduced endopod and only two spinules on the basis, and by the very small P2 endopod carrying only one apical seta in both sexes. In addition, the male P3 has only one spinular row on exp-1, and is most similar to the one of *S. diversitatis*, *S. pasquini*, and *S. lorenzae* in the absolute and relative length of thumb and apophysis. The P1 basis of males has one hook and one seta as in *S. diversitatis* and *S. pasquini*. The male P5 is characterized by a large pore, and the P5 of both sexes carries the inner tip and 4 setae, the second outermost one is very reduced and spiniform, as recorded in *S. pasquini*. *Stammericaris destillans* has an elliptical dorsal integumental window on the cephalothorax but no dorsal elliptical integumental windows on the urosomites, a very rare condition in Parastenocarididae, where the most common condition is the presence of dorsal windows on cephalothorax and urosomites (Galassi and de Laurentiis 2004, Corgosinho *et al.* 2007) (as in *S. diversitatis*); in the other species of the genus there are no windows at all (as in *S. trinacriae*), with the exception of *S. diversitatis*. However, windows were rarely taken into account in the earlier descriptions of several species of Parastenocarididae.

Redescription of *Stammericaris trinacriae* and additional features of *S. amyclaea* and *S. orcina*. The comparison of specimens of *S. trinacriae* from the new population (Entella Cave) with the type series of this species, and the re-examination of specimens of *S. amyclaea* and *S. orcina* from our collection, allowed us to review and widen the original descriptions. The morphology of *S. trinacriae* from Entella Cave is very similar to the specimens from the type locality (a well near Petrosino, around 50 km west of Entella Cave; see Pesce *et al.* 1988), except that the caudal rami of both sexes are proportionally shorter in the typical series than in the Entella population (Fig. 9C, G). In addition: 1) in the original description of the male antennule, the ornamentation is incomplete, and the pocket-knife morphology is not reported (see discussion on this issue in Bruno and Cottarelli 2015), but the holotype has an A1 with a pocket-knife morphology and same ornamentation like the specimens from Entella Cave (Fig. 9D) and even the shape and size of the two aesthetascs (fifth and eighth segment) are similar; 2) the hook on the inner margin of the P1 basis of males is not recorded in the original description, but at that time the P1 basis ornamentation and armature were not usually described in detail – unfortunately, the hook is not visible on the holotype specimen, which has become too transparent to discern such a character, but, on the other hand, the small seta on the P1 basis of the paratype female is easily visible; 3) the morphology and ornamentation of P2 and P3 of both sexes, and chiefly the morphology of male P3, characterized by the long, downwardly pointed distal process inserted on the inner margin of exp-1, and by the very long, inwardly-bent apophysis on the exp-2 are, to our knowledge, not shared by any other Italian Parastenocarididae. In the original drawing and description the endopod of male P3 and the long outer seta on the basis are missing, and indeed, the long and very thin endopod is present in the holotype (Fig. 9E), where the long outer seta of basis is not visible but might have been lost during dissection; 4) the female P3 endopod in the original drawing is as long as the corresponding exp-1, and spinulose in the apical third, however, the new specimens we examined, and the reexamined original paratype has a smooth endopod, shorter than the corresponding exp-1 (Fig. 9H); 5) the male P4 is very similar to the original description in shape, with the exception of the endopod, which lacks the spinule inserted at half of the outer margin, but this spinule is indeed present (Fig. 9F); 6) the ornamentation of P5 of both sexes is the same for the original description and our specimens, where the outermost seta is inserted in a protruding lobe, which carries the basipodal seta. The shape of P5 was not comparable because the original drawing according to us is incomplete (i.e., the origin of P5 and the fusion to the intercoxal plate are not represented). The re-examination of the female paratype shows that the insertion and fusion to the intercoxal plates is the same as in the Entella population (Fig. 9J).

We examined the male holotype of *S. amyclaea* and we detected a pocket-knife shaped male A1, as it is typical for the genus (Fig. 10B). In the original drawing (Cottarelli 1969: page 17, Fig. 7) the drawing of the armature of the male A1 was incomplete: the setal formula is in fact 0, 6, 4, 2, 4 + ae, 0, 0, 9 + ae. The male P1 basis (Fig. 10C) has a single slender seta on outer margin and a hook originating together with a spinule from a small protrusion on the inner margin of basis. The original description of the armature of the caudal rami was incomplete: the correct morphology is shown in Fig. 10A. In addition, the female P5 was incorrectly described, and the armature is represented by three setae and one long tip, and not by two setae and one tip (see Cottarelli 1969: Table V, Fig. 14). The re-examination of the specimens of *S. orcina* in our collection allowed us to detect a pocket-knife male A1 which had never been described before. All the other features diagnostic for the genus correspond to the description in Cottarelli and Drigo (1972).

With regards the attribution of *S. trinacriae* to the genus *Stammericaris*, Schminke (2013) already noted that this species did not share all the characters required for a confident attribution to the genus; in particular the same author stated: “endopod P4 male having the typical appearance, whereas the P3 male and the endopod P3 female are different” and concluded that, regardless of these differences *P. trinacriae* is regarded here as a member of the species discussed here and because of its elongate apophysis of the P3 male. However, we detected characters that reinforce this attribution; specifically, the male A1 is clearly eight-segmented and strongly modified in the typical pocket-knife shape; and the endopod P3 female is half as long as or shorter than first segment of corresponding exopod (Fig. 9H, A). As regards the P1 basis ornamentation, the generic diagnosis states that “P1 male (with one exception) without hook and seta near endopod insertion” (Schminke 2013). The exception refers to *S. diversitatis*; however, our re-examination of the published descriptions and the morphological details show that this feature is present also in *S. pasquinii*, whereas in *S. trinacriae* and *S. destillans* the males have only the hook. Hence, in *Stammericaris* the presence of armature on the P1 basis of males (and females) is rather frequent.

TABLE 3. List of morphological characters, and their status, for the Parastenocarididae species analysed and/or discussed for morphological affinities.

	<i>S. destillans</i> sp. nov.	<i>S. diversitatis</i>	<i>S. trimacriata</i>	<i>S. pasquini</i>	<i>P. amalasuntae</i>	<i>S. orcina</i>	<i>S. amyclaea</i>	<i>P. crenobia</i>
A1, male: 8-segmented, pocket-knife type	Yes	Yes	Yes	Yes	No	Unknown	Unknown	Yes
Ornamentation basis P1, male	Hook and seta	Hook and seta	Hook	Hook and seta	Without ornamentation	Unknown	Hook	Hook
Ornamentation basis P1, female	Seta	Seta	Seta	Seta	Without ornamentation	Unknown	Seta	Unknown
Position of spinules on outer margin of P3 exp-1, male	Proximal	Proximal and distal	Without spinules	Proximal and distal	Without spinules	Proximal and distal	Proximal and distal	Proximal and distal
P3, male: apophysis long with rounded tip and slightly curved inwards, twice as long as the thumb or longer	Yes	Yes	Yes	Yes	No, apophysis is shorter	Yes	Yes	Yes
Basis P4, male: inner row of curved spinules decreasing in size laterally	2 spinules	3 spinules	3 spinules	3 spinules	No spinules	4 spinules	3 spinules	2 spinules
Enp P4, male: curved plate with pointed inner tip with two outgrowths on outer border, the distal one a feathered or plain seta	Distal outgrowth reduced to a small lobe	Yes	Yes	Yes	No, apically acute appendix with denticles on lateral margin	Yes	Yes	Stalked spheroidal tip with two spinules
P5, male: small, trapezoidal or rectangular, inner-distal corner produced into small pointed tip	Yes	Yes	Yes	Yes	Triangular, strong inner tip	Yes	Yes, but strong inner tip	Unknown
Caudal rami: cylindrical and almost as long as anal somite	As long as	Slightly shorter	Longer	As long as	Shorter	Longer	Shorter	Slightly shorter
Caudal rami: group of lateral setae at end of rami	Yes	Yes	Yes	Yes	Lateral setae at 1/3	Yes	Yes	Yes

Compared to other species of the genus, *S. trinacriae* is characterized by the structure of the male P3, in particular the distal apophysis longer than exp-1, the lack of spinule rows on the outer margin of exp-1, and the long, downward-pointed distal apophysis on the inner margin of exp-1. The conical proximal tubercle on the inner margin of exp-1 is particularly large and not fused to the exopod, a condition not present in any other *Stammericaris*. The apophysis and tubercle are present, even if less developed (especially the distal apophysis), in several other species of the genus, such as *S. pasquinii* and *S. diversitatis*. Moreover, *S. trinacriae* differs from the other species of the genus for the very long distal apophysis (ancestral exp-2), which is as long as exp-1 or longer, the long, downward pointed distal process on exp-1 and the lack of two longitudinal spinular rows on the outer margin of exp-1. Within the genus, an apophysis of similar length has been noted for *S. orcina* and *S. amyclaea*. The caudal rami of both sexes are not dimorphic (as typical of the genus), longer than the anal somite, and resemble those of *S. orcina* where, however, caudal rami are proportionally longer. *Stammericaris trinacriae* has only one hook on the male P1 basis, as *S. amyclaea* and maybe *S. lorenzae*, and three spinules near the insertion of the P4-enp in males as in *S. stammeri*, *S. amyclaea*, *S. diversitatis*, *S. pasquinii*, although the size of the three spinules varies among species. The P5 is sexually dimorphic in several species of the genus, larger and with a proportionally longer and stronger inner tip in females, in *S. trinacriae* the armature is represented by four setae and the tip, longer in females, as in *S. orcina*.

Phylogenetic relationships among species of *Stammericaris* and between this genus and *Proserpinicaris*.

Most published molecular studies of copepods have investigated marine species (see Zagoskin *et al.* 2014, and references therein), whereas those of freshwater, free-living copepods are comparatively few (Karanovic & Cooper 2011a, b; Karanovic *et al.* 2015). Here we provide the first 18S sequences for some Italian Parastenocarididae and analyse their phylogenetic relationships based on COI and 18S sequences.

The genetic distances measured for the COI/18S fragments between *P. amalasuntae* and the Italian *Stammericaris* we studied indicate that these species belong to separate genera, given that similar genetic distances were found between three Australian parastenocaridid genera (Karanovic & Cooper 2011a). In addition, phylogenetic relationships based on ML and BI indicated that *Proserpinicaris* and the Italian *Stammericaris* belong to two clusters. This result also confirms the detailed description of the morphology of the genus *Proserpinicaris* provided by Karanovic *et al.* (2012), which can be distinguished from *Stammericaris* based on many morphological features (Table 3).

Genetic distances of COI sequences between species within the Italian *Stammericaris* were also quite high, although such interspecific genetic distance values are not unusual for crustaceans (Lefébure *et al.* 2006), marine copepods (Blanco-Bercial *et al.* 2014), and other harpacticoid copepods such as *Kinnecaris* sp. (Karanovic & Cooper 2011a) and *Stenhelina* sp. (Karanovic *et al.* 2014). In our phylogenetic analysis *S. destillans* was assigned to the Italian *Stammericaris* cluster. However, the monophyly of this group of species was only weakly supported and might be related to the low number of sequenced specimens. Similarly, the species clusters within *Stammericaris* did not entirely confirm the morphological affinities between *S. destillans*, *S. pasquinii* and *S. diversitatis*. Additional *Proserpinicaris* and *Stammericaris* species are needed to complete our understanding about species delimitations and evolutionary relationships in this family.

Amendment of the genus *Stammericaris* and affinities among species of the genus. The results of the molecular analysis, indicating that *S. destillans* is a species within *Stammericaris*, aided the interpretation of the morphological data which, taken alone, would have excluded this species from *Stammericaris*. Whereas Schminke (2013) emphasized the shape of the male P4 endopod in the definition and discrimination of this genus, *S. destillans* shares all the features characteristic of the genus as listed by Schminke (2013) except the typical male P4 endopod, which in this species is in fact one-segmented, represented by a cylindrical element distally enlarged in three pointed protrusions, the middle one strongest and apically curved outwards. However, the male P4 endopod of *S. destillans* can be considered a modification of the characteristic structure of the genus (i.e. “a curved plate with a pointed inner tip carrying at its outer border two outgrowths, the distal one being a feathered or plain seta” (Schminke 2013)), since the distal seta as reduced to a tubercle and the inner tip and proximal outgrowth transformed into the two (inner and outer) protrusions, which are proportionally smaller than those of other species in the genus because the entire endopod is smaller.

Some of the species of the *minuta*-group (*sensu* Lang, 1948), as yet not assigned to any of the genera discussed above, share several diagnostic morphological features with *S. destillans* and will probably be reassigned to different genera in the future. This is the case of *Parastenocaris narentina* Petkovski 1959 and of *Parastenocaris*

crenobia Galassi 1997, listed by Schminke (2010) as *Parastenocaris incertae sedis* within the subfamily Parastenocaridinae. Even if the females of *P. crenobia* are unknown, the similarities in features among the three species are striking (Table 3). However, a precise systematic definition of *P. crenobia* will require the collection and description of the female, and the support of a molecular analysis. On the other hand, *P. narentina* remains, in our opinion, *species inquirenda* due to the lack of a detailed description and chiefly because several morphological features (e.g., the morphology and ornamentation of the male P2 endopod and P3) do not correspond to the ones observed in *S. destillans*. Based on these observations, we have amended the diagnosis of the genus *Stammericaris*. Many of the characteristic features of *Stammericaris* are not exclusive of this genus, but are shared as characters that identify other genera of Parastenocaridinae, such as the pocket-knife type male antennule. This is not surprising, considering that convergence phenomena are frequent in the different lineages of this subfamily. However, the set of characters considered as a whole and the molecular data justify in our opinion the existence of *Stammericaris* as amended herein.

Distribution and ecology. According to Schminke (2010), the genus *Stammericaris* is scattered around the Mediterranean, from *S. stammeri* in the Pyrenees, Spain, to *S. phreatica* in Romania and the Czech Republic. *Stammericaris trinacriae* and *S. destillans* confirm the Perimediterranean distribution of the genus (Fig. 16). These two *Stammericaris* together with *S. diversitatis* are endemic to Sicily. *Stammericaris diversitatis* and *S. destillans* have a very narrow distribution, being endemic to the single cave where they were collected, whereas *S. trinacriae* was originally described from two wells about 30 and 50 km west of the Entella Cave (Pesce *et al.* 1987), and therefore has a wider distribution.

Stammericaris trinacriae, the first and only parastenocaridid collected in Sicily in gypsum caves, was collected in Entella Cave with the stygoxenes *Phyllognathopus viguieri* (Maupas 1892); *S. diversitatis* was collected with the stygobiotic *Bryocamptus (Rheocamptus) stillae* Cottarelli and Bruno, 2012 and *Speocyclops italicus* Kiefer, 1938. No other copepod taxa were collected with *S. destillans* in the Molara cave. The copepod assemblages of the three investigated caves apparently have a lower species diversity compared to other similar Italian and European caves. For instance, in the Slovenian epikarstic system, Brancelj (2002) recorded one cyclopoid and 11 harpacticoid taxa from 19 puddles and basins on eight sampling dates in Velika Pasjica; Pipan and Brancelj (2004) recorded four taxa of cyclopoids and 19 taxa of harpacticoids from the trickles and pools in three caves of the Postojnska Jama Cave System. In Northeastern Italy, Galassi *et al.* (2009) collected 13 harpacticoid and three cyclopoid taxa from several samples of the unsaturated zone of karstic aquifers in the Lessinian massif. The lower diversity recorded in the Sicilian caves could be due to the stressful environmental conditions such as hydrological intermittency, high surface temperatures, and high ionic concentration (e.g., the very high sulfates concentration recorded in the drip pools of Entella Cave by GR, MTS, MCB, VC, unpubl. data), which only allow the survival of tolerant taxa such as some stygobiotic Parastenocarididae.

Remarks on conservation. Di Maggio *et al.* (2012) noted that the carbonate and gypsum karst area of Sicily “are of great environmental value because they contain a variety of habitats that hold species of biogeographic significance; however, such habitats are increasingly threatened by water pollution, urbanization, and tourism”. The discovery of new species in Sicilian caves (e.g. Brancelj 2009; Pipan *et al.* 2010; Mazzini *et al.* 2017; this paper) underlines the importance of the epikarst as an untapped source of biodiversity including a rich array of small crustaceans, especially copepods, often rivalling in diversity the rest of the aquifer (Pipan & Brancelj 2004; Pipan & Culver 2006). Fortunately, all three caves studied here are part of a karst system designated as Nature Reserve by the Sicilian Regional Government in 1981, which provides a long-term protection of their unique stygobiotic fauna. However, as discussed by Pipan *et al.* (2010), the protection of epikarst habitats requires a shift of emphasis from the protection of caves to the protection of the surface areas above the epikarst, which lies only a few meters below the surface. Therefore, specific legislation and protection measures of the vulnerable epikarstic layer is still needed, as well as a unified strategy and planning for all Sicilian karstlands, as already advocated, for instance, by Abbate (2011) and Di Maggio *et al.* (2012).

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