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On three new species of *Echinogammarus*, related to *E. veneris*
(Heller, 1865), from Italy and Switzerland
(Crustacea, Amphipoda)

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ABSTRACT

Description of three freshwater species of *Echinogammarus*, viz. *E. fluminensis* n.sp. (from northern Italy and southern Switzerland), *E. ruffoi* n.sp. (from northern Italy), and *E. tibaldii* (from central Italy). New records and some notes on the morphology of *E. veneris* (Heller) in Italy are provided. A table summarizes the salient morphological differences between these closely related species and *E. pungens* (H. Milne Edwards).

INTRODUCTION

In a recent revision of the *Echinogammarus pungens*-group (Stock, 1968), the species *E. veneris* was redescribed after the type-specimens, and was recorded from a number of localities, several of which in Italy. At the same time it was felt (Stock, l.c.: 14) that the number of samples examined from Italy was too small to preclude further splitting of *veneris*-like *Echinogammarus* in the future. The opportunity to do more detailed taxonomic work on these amphipods was offered sooner than expected: through own collecting activities (chiefly in the great lakes in northern Italy and in the river-system of the Po) and through the kindness of Dr. A. Nocentini (Pallanza) and Dr. E. Tibaldi (Milano), who collected samples in various parts of Italy, we could examine 41 additional samples from Italy and Switzerland, south of the Alps. Moreover, 13 samples preserved in the British Museum (Natural History), London, and the Muséum National d'Histoire Naturelle, Paris, have been examined. As a result of this study, we are able to distinguish three new species of *Echinogammarus*, close to, but by no means identical with, *E. veneris* (Heller, 1865). Two of the new species occur alone in some localities,

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Salient morphological differences between the members of the *Echinogammarus pungens*-group in Italy (chiefly based on adult ♂)

	<i>pungens</i>	<i>veneris</i>	<i>fluminensis</i>	<i>ruffoi</i>	<i>tibaldii</i>
<i>First antenna</i> segment 2	shorter than segment 1	shorter than segment 1	subequal to segment 1	shorter than segment 1	shorter than segment 1
segment 3	more than $\frac{1}{2}$ segment 2, $2\frac{1}{2}$ × as long as wide	about $\frac{1}{2}$ segment 2, $2-2\frac{1}{2}$ × as long as wide	more than $\frac{1}{2}$ segment 2, 3 × as long as wide	slightly more than $\frac{1}{2}$ segment 2, $2\frac{1}{2}$ × as long as wide	much more than $\frac{1}{2}$ segment 2, 3 × as long as wide
no. of groups of elements on ventral margin of segment 1 (incl. terminal group)	3 (setae short)	2-3 (setae short)	5-6 (setae longer)	2-3 (setae short)	4 (setae longer)
do., on segment 2	4	4-6	6-11	4-5	5-7
do., on segment 3	2-3	2-4	4-7	2-3	4-5
flagellum	with short setae	with rather short setae	with short setae	with rather short setae	with very long setae
<i>Second antenna</i> no. of groups of elements on ventral margin of segment 4 (incl. terminal group)	4	5	6-7	4-5	6
do., on segment 5	3-5	6-8	5-7	5-6	5-7
ratio longest seta dorsal margin/longest seta ventral margin (on segment 5)	1/3	1/2-2/3	1/3	1/2	1/2-2/3
no. of setae on basal segments of flagellum	9-12	13-20	8-11	12-15	> 25
flagellum segments	not flattened, with calceoli	dorsoventrally flattened, with calceoli	not flattened, with calceoli	slightly flattened, with calceoli	hardly flattened, usually without calceoli
<i>Second leg</i> no. of palmar angle spines	2	3	3	2	4
<i>Third leg</i> menus	with straight setae	with straight setae	with straight setae	with straight setae	some setae curled

<i>Third and fourth legs</i> propodal sole	with setae only	with spines and setae	with spines and setae	with spines and setae
<i>Fourth leg</i> no. of groups of elements on anterior margin of merus	3—4	2	3	3
<i>Fifth leg</i> posterior margin of basis	with closely set short setules	short setules less closely set	longer setules, closely set	short setules less closely set
<i>Sixth leg</i> inner surface of basis	with many setules	with few setules	with few setules	with few setules
posterior margin of basis	setules closely set	setules less closely set	setules closely set	setules less closely set
<i>Seventh leg</i> distance between the setules on the posterior margin of the basis	$\frac{1}{30}$ of greatest diameter of the basis	$\pm \frac{1}{10}$	$\pm \frac{1}{10}$	$\pm \frac{1}{10}$
no. of groups of elements on posterior margin of merus and carpus	1 or 2 (setae longer than spines)	2 to 4 (setae longer than spines)	1 or 2 (setae longer than spines)	2 to 3 (spines longer than setae)
<i>Urosome</i> dorsal elevations	compressed, high	usually compressed, high	not compressed, very low	compressed, high
dorsal armature	setae longer than spines	setae longer than spines	setae longer than spines	setae shorter than spines
<i>Epimeres 2 and 3</i> no. of setules on posterior margin	several	2—4	1—2	several
<i>Uropod 3</i> setae on exopod	nearly all plumose	nearly all plumose	nearly all plumose	nearly a half plumose
<i>Telson</i> distal armature	setae longer than spines	setae longer than spines	setae longer than spines	setae and spines of equal length

but live in mixed populations in others. In one locality mixed populations of these two new species and of *E. veneris* s.str. were observed. In the mixed populations no illegitimate couples have been found, and morphological intermediates have not been seen either. This proves in our opinion two things: (1) the morphologically recognizable “forms” behave like “good species”, and (2) since they occur together in the same habitat, they cannot be considered ecophenotypic variants (“Standortsmodifikationen”).

In the present paper the three new species are described, and some notes on the morphology of the Italian populations belonging to *E. veneris* s.str. are provided.

KEY TO THE SPECIES OF *Echinogammarus* (BASED ON ADULT ♂) KNOWN FROM ITALY

- 1a) Lower margin of coxal plates practically without setules. Merus of P5 about 1½ times as long as wide *E. foxi* (Schellenberg, 1928)
Chivasso, affluent of river Po.
- b) Lower margin of coxal plates more or less setiferous. Merus of P5 more than 1½ times as long as wide 2
- 2a) Third peduncle segment of A1 2 to 2½ times as long as wide 3
- b) Third peduncle segment of A1 nearly or entirely 3 times as long as wide 6
- 3a) Setae on telson and on urosome shorter than the spines. Posterior margin of basis of P7 with very short setules *E. stammeri* (Karaman, 1929)
Monfalcone, near Trieste
- b) Setae on telson and on urosome longer than the spines. Posterior margin of basis of P7 with long to very long setules 4
- 4a) Peduncle segments 4 and 5 of A2 densely setose 5
- b) Peduncle segments 4 and 5 of A2 not excessively setose
. *E. pungens* (H. Milne Edwards, 1840)
“Mont Cassini en Italie” (by original designation of Milne Edwards)
- 5a) Exopod of uropod 3 with reduced number of plumose setae. Merus of P7 with 4 to 5 groups of elements on its posterior margin *E. ruffoi* n.sp.
Plain of the Po
- b) Exopod of uropod 3 with nearly all setae plumose. Merus of P7 with 2 to 4 groups of elements on its posterior margin *E. veneris* (Heller, 1865)
Entire Italy, in streams and lakes
- 6a) Setae on the posterior margin of merus and carpus in P7 shorter than the spines. Flagellum of A1 densely setose *E. tibaldii* n.sp.
Central Italy
- b) Setae on the posterior margin of merus and carpus in P7 longer than the spines. Flagellum of A1 sparingly setose *E. fluminensis* n.sp.
Northern Italy

DESCRIPTIVE PART

Echinogammarus veneris (Heller, 1865). Fig. 4 e-g.

Lit. & syn.: see Stock, 1968: 33.

Material examined from Italy. —

A list of localities in Italy has been published in Stock, 1968: 34. From this list the locality Riete must be removed, since it rests on confusion with

E. tibaldii (see under that species). The locality named "Grotta del Mago" is erroneously classified under the heading "Italy"; in reality it is situated in Switzerland (cf. B. Wolf, *Animalium cavernarum catalogus*, 1 : 400, 1934-37); the species collected in this cave is not *E. veneris* but *E. fluminensis* (see under that species).

After preparation of Stock's enumeration, the following new Italian records became known to us:

Many specimens, brook just E. of Roncoferraro (prov. Mantova), in waterweeds, 16 Apr. 1969 (Cl 17 mg/l).

4 ♂, 5 ♀, River Po, near confluence with Fiume Mincio (prov. Mantova), muddy shore and inundated meadows, 16 Apr. 1969.

13 specimens, Lago di Bolsena (prov. Roma), depth 5 m, 14 May 1968 (coll. A. Nocentini).

Remarks. — Some new illustrations are inserted in this paper, showing a number of salient characters of the population of Roncoferraro in northern Italy (figs. 4 e-g).

***Echinogammarus fluminensis* n.sp. Figs. 1-2.**

Material examined:

ITALY:

1 ♂ (holotype) and more than 100 paratypes. Lago di Garda (prov. Verona), shore at Cassone, in moss on stones, 17 Apr. 1969 (ZMA Amph. 102.270).

Many specimens, Lago di Garda (prov. Verona), embankment at Malcesine, diatoms, 17 Apr. 1969.

About 20 specimens, Lago di Garda (prov. Verona), near S. Vigilio, cobble beach, 17 Apr. 1969.

Many specimens, Lago di Garda (prov. Verona), littoral zone South of Torri di Benaco, stones, 15 Apr. 1969 (Cl 6 mg/l, Ca 21.2 mg/l).

19 specimens, spring discharging in the Lago di Garda (prov. Verona), at Cassone, cobbles, 17 Apr. 1969 (Cl 2 mg/l, Ca 29.6 mg/l).

Many specimens, Fiume Tartaro, S. of Verona, near Pellegrina (prov. Verona), fast running, in waterweeds, 16 Apr. 1969 (Cl 13 mg/l, Ca 73.8 mg/l).

33 specimens, Fiume Tartaro, just NW. of Nogara (prov. Verona), fast running, in waterweeds, 16 Apr. 1969.

13 specimens, brook N. of Buttapietra (= S. of Verona) (prov. Verona), cobbles, waterweeds, 16 Apr. 1969.

Many specimens, Fiume Tione, about 5 km W. of Villafranca-di-Verona (prov. Verona), slightly polluted, in moss, 14 Apr. 1969 (Cl 9 mg/l, Ca 97.3 mg/l).

Many specimens, Fiume Mincio near Valeggio (prov. Verona), polluted, in waterweeds, 14 Apr. 1969 (Cl 8 mg/l, Ca 28.0 mg/l).

Many specimens, Fiume Tione near Villimpenta (prov. Mantova), cobbles, muddy, 16 Apr. 1969.

Many specimens, brook just E. of Roncoferraro (prov. Mantova), in waterweeds, 16 Apr. 1969 (Cl 17 mg/l).

12 specimens. Brook between Leno and Manerbio (prov. Brescia), in moss on stones, 14 Apr. 1969 (Cl 8 mg/l, Ca 99.8 mg/l).

Many specimens, affluent of Fiume Oglio, 6.5 km WNW. of Verolanuova (prov. Brescia), running water, steep clay banks, 14 Apr. 1969.

Many specimens, Fiume Oglio, about 1 km E. of Soncino (prov. Cremona), cobbles, waterweeds, 14 Apr. 1969 (Cl 5 mg/l, Ca 53.1 mg/l).

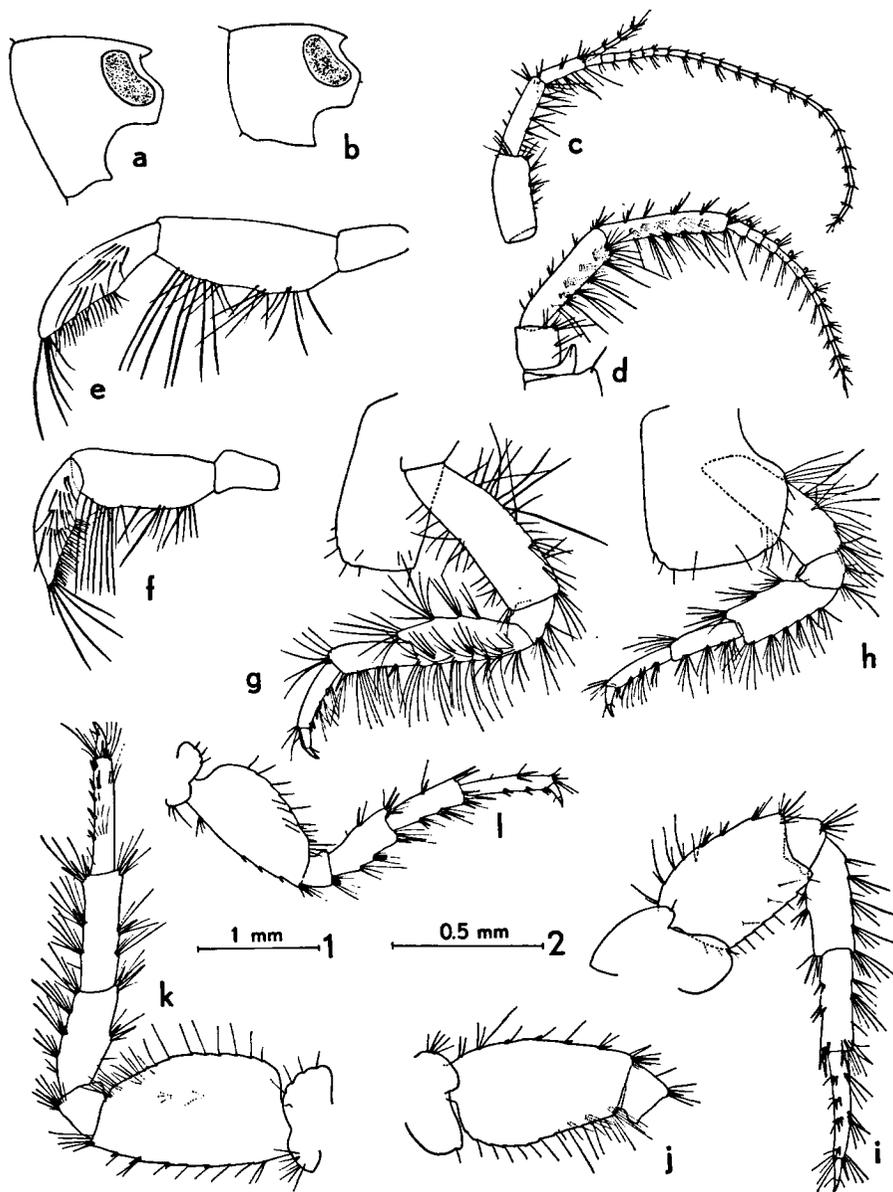


FIG. 1. *Echinogammarus fluminensis* n.sp., ♂ (all from the Fiume Tione, except for l which is from the Lago Maggiore). a, b, cephalic segment of two different specimens; c, first antenna; d, second antenna; e, f, mandible palp of two different specimens; g, third leg; h, fourth leg; i, fifth leg; j, proximal segments of sixth leg; k, seventh leg; l, seventh leg of a young male. Figures e and f to scale 2, all others to scale 1.

Many specimens, brook 8 km SW of Soncino (prov. Cremona), muddy, *Elodea*, 14 Apr. 1969 (Cl. 6 mg/l, Ca 41.3 mg/l).

Many specimens, Fiume Adda, about 4 km E. of Paullo (prov. Milano), cobbles, 14 Apr. 1969 (Cl 5 mg/l, Ca 41.8 mg/l).

About 20 specimens, affluent of Fiume Adda, 1 km E. of Paullo (prov. Milano), fast running, muddy, plants, 14 Apr. 1969 (Cl 4 mg/l, Ca 21.7 mg/l).

Many specimens, Canale Muzza, near Paullo (prov. Milano), cobbles, diatoms, 14 Apr. 1969 (Cl 7 mg/l, Ca 49.0 mg/l).

14 specimens, Fiume Ticino, bridge in highroad A4 near Magenta (prov. Milano), cobbles, diatoms, rapids, 20 Apr. 1969 (Cl 5 mg/l, Ca 14.0 mg/l).

Many specimens, Torrente Agogna, SW. of Novara (prov. Novara), cobbles, 20 Apr. 1969 (Cl 25 mg/l, Ca 15.6 mg/l).

Many specimens, Fiume Sésia near Vercelli (prov. Novara), cobbles, 20 Apr. 1969 (Cl 7 mg/l, Ca 23.3 mg/l).

Many specimens, affluent of river Po near Trino (Laboratory of Centrale E. Fermi) (prov. Novara), in waterweeds, 20 Apr. 1969 (Cl 9 mg/l, Ca 75.9 mg/l).

About 20 specimens, river Po, S. of Trino (prov. Novara), 7 Aug. 1968 (coll. E. Tibaldi).

Many specimens, Lago Maggiore (prov. Novara), depth 0—5 m, 1960—1961 (coll. A. Nocentini).

Many specimens, Torrente Orco, W. of Chivasso (prov. Torino), stones, fast running, 20 Apr. 1969 (Cl 7 mg/l, Ca 10.3 mg/l).

Many specimens, Torrente Malone, W. of Chivasso (prov. Torino), stones, 20 Apr. 1969 (Cl 6 mg/l, Ca 13.8 mg/l).

About 25 specimens, Lago di Como, Lido di Cernobbio (prov. Como), rather polluted, cobbles, 21 Apr. 1969 (Cl 3 mg/l, Ca 15.1 mg/l).

About 10 specimens, Lago di Como, shore S. of Argegno (prov. Como), large stones and diatoms, 21 Apr. 1969.

2 specimens, Lago di Montórfano (E. of Como) (prov. Como), in waterweeds, 21 Apr. 1969 (Cl 4 mg/l, Ca 35.8 mg/l).

9 specimens, Fiume Brembo (prov. Bergamo), 8 Sep. 1968 (coll. E. Tibaldi).

Many specimens, Fiume Brembo (prov. Bergamo), 10 Mar. 1968 (coll. E. Tibaldi).

SWITZERLAND:

Many specimens, Lago di Lugano, shore near Maroggia (canton Tessin), cobbles near mouth of brook, 21 Apr. 1969 (Cl 5 mg/l, Ca 31.6 mg/l)

1 ♂, Grotta del Mago (= near Rancate) (canton Tessin), 3 Oct. 1956 (collection MNHN).

Description. — Adult male. Maximal total length (excluding antennae) about 12 mm. Large males seem to be more frequent in rivers than in lakes.

Lateral head lobes angularly rounded (figs. 1 a, b); eyes large and rather wide. No dorsal keel on the metasome, no groups of spinules either.

The first antenna (fig. 1c) is characteristic in having the 2nd peduncle segment equal in length to, or even slightly longer than, the first. Third peduncle segment remarkably slender, more than half as long as the second segment and about 3 times as long as wide. On the ventral margin of the first peduncle segment, 5 to 6 groups of setae arise (including the terminal group), the longest of which are as long as the diameter of the segment. On the 2nd and 3rd peduncle segments 6 to 11 and 4 to 7 groups of elements, respectively, arise; the longer setae are twice as long as the diameter of the segment.

The flagellum has 20 to 25 segments and bears a small number of short setules (not much longer than the diameter of the flagellum segments) only. The accessory flagellum is 4- to 5-segmented.

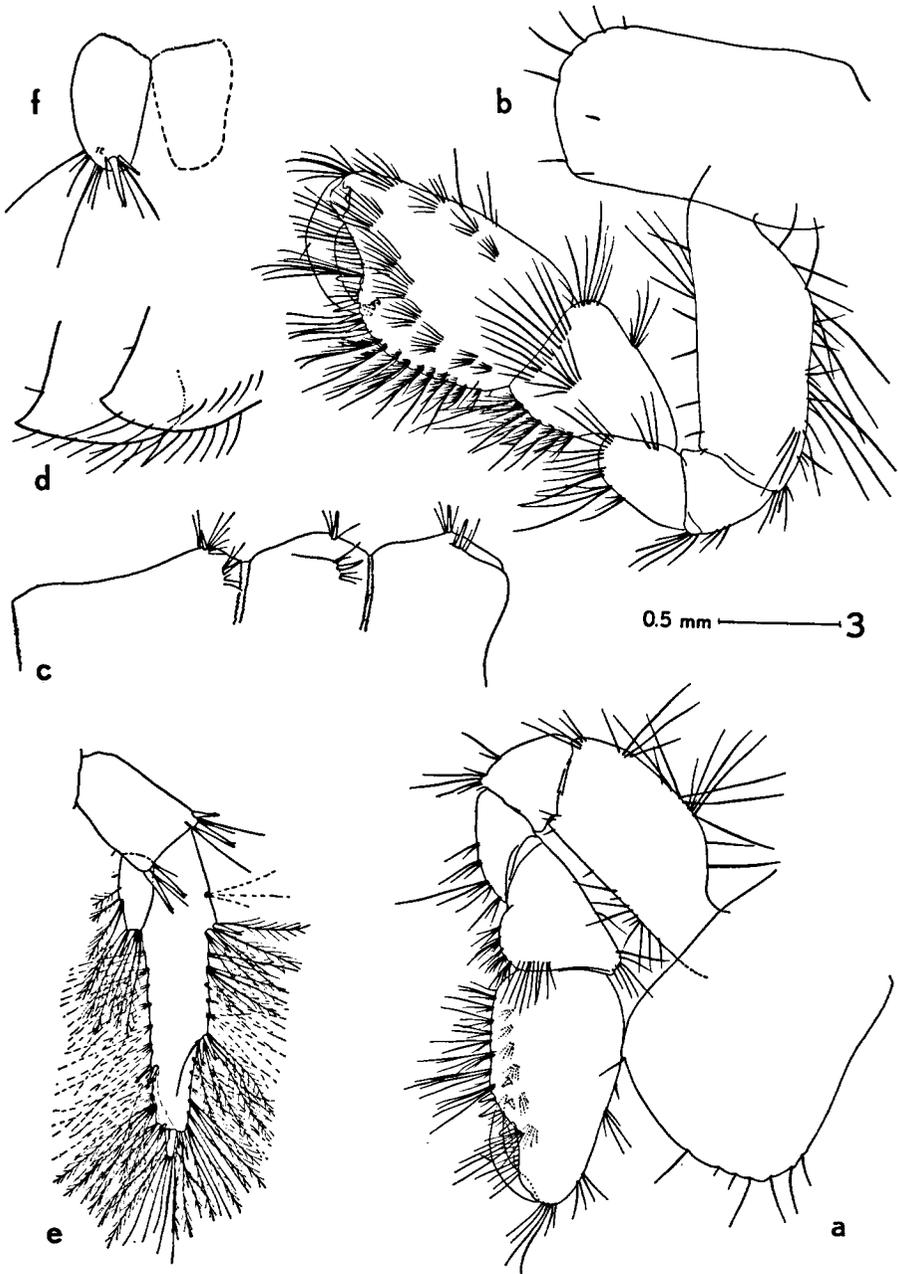


FIG. 2. *Echinogammarus fluminensis* n.sp., ♂ (all from the Fiume Tione). a, first leg (scale 3); b, second leg (scale 3); c, contour of the urosome, from the left (scale 3); d, second and third epimeres (scale 1); e, third uropod (only a small number of bunches of setae are drawn, the others are just indicated) (scale 3); f, telson (scale 2).

The second antenna (fig. 1d) has a short, straight, tapering gland cone. Segments 4 and 5 of the peduncle are slender, armed on their ventral margin with 6 to 7, and 5 to 7 groups of setae, respectively (including the terminal group). The same number of groups of setae is found on the median surface of these peduncle segments. On the dorsal margin of the same segments groups of short setae, containing a small number of elements only, occur. The setae on the ventral margin are the longest (about twice as long as the diameter of the peduncle segment that carries them), the median setae are distinctly shorter, the longest dorsal setae reach only $\frac{1}{3}$ of the length of the longest ventral setae. Flagellum rather short, 11- to 14-segmented, proximal 5 to 7 segments with calceoli. Flagellum segments not or hardly dorso-ventrally flattened, armed with a small number (6 to 11 on the proximal segments) of setules, which are much shorter than the peduncular setae.

Mandible palp (figs. 1e, f) with an unarmed basal segment. Second segment rather robust, armed with 2 groups of setae on the lower margin; the proximal group consists of 10 to 15 setae and nearly shades off into the distal group consisting of about 9 setae. The distal segment is provided with 5 terminal setae, a regular (comb-like) row of ventral setules, and several groups of lateral setae.

The first leg (gnathopod 1) is as illustrated in fig. 2a. The coxal plate bears only a few short setules on its lower margin. The propodus is elongate, slightly tapering. The palm is rather oblique; there are two palmar angle spines and one obtusely rounded mid-palmar spine.

The second leg (gnathopod 2) bears, like the first, a few short setules on the ventral margin of its coxal plate (fig. 2b). The propodus is larger, less slender, and has a less oblique palm than the first leg. There are, at least in larger males, three palmar angle spines. The mid-palmar spine is implanted rather close to the angle spines, so that hardly any gap exists between the mid spine and the angle spines.

The third leg (fig. 1g) bears hardly any setules on the lower margin of its coxal plate. The anterior margin of the merus bears usually 4 groups of long setae, the posterior margin usually 7 groups of long setae. The propodal sole is armed with setae and spines.

The fourth leg (fig. 1h) bears hardly any setules on the lower margin of its coxal plate. The anterior margin of the merus is provided with 3 groups of elements (spines and setae), the posterior margin with 7 groups. The propodus resembles that of leg 3.

The fifth leg (fig. 1i) has a rectangular basis, the posterior margin of which is crenulated and provided with short setules. The posterior margin of the merus bears usually 3 groups of elements (spines and setae of nearly equal length, elements much shorter than the diameter of the merus). The carpus bears spines at the posterior, setae at the anterior margin.

The sixth leg has a slightly tapering basis (fig. 1j), the posterior margin of which bears medium long setae (longest setae clearly shorter than the diameter of the basis).

The seventh leg (fig. 1k) has a tapering basis, the gently curved posterior

margin of which bears medium long setae (much shorter than the diameter of the basis). The inner surface of the basis is ornamented with very few isolated setules only. The merus bears usually three groups of elements on its posterior margin (including the terminal group); these elements (spine and setae) are clearly shorter than the diameter of the merus. The carpus likewise bears 3 (rarely 4) groups of elements on its posterior margin. The setae on the propodus are short.

The urosome segments bear low dorsal elevations, which are not compressed (fig. 2c). The "saddle" on urosome segment 1 is shallow and indistinct. The dorsal armature (variable as it is) most usually consists of 1 dorsal and 1 dorsolateral spine, accompanied by 2 to 5 setae that are as long as or only slightly longer than the spines.

The epimeres 2 and 3 have slightly produced, pointed hind corners (fig. 2d); their ventral margins are provided with long setae; their posterior margins with one, rarely two, short setules only.

The third uropod (fig. 2e) has a short, tapering inner ramus and a 2-segmented outer ramus. Both rami bear long setae, the majority of which is plumose (at most only one seta per bunch is smooth).

The telson (fig. 2f) consists of two roughly ovate lobes, usually without subbasal spines; the terminal armature consists of spines (usually two) and setae, some of which overreach the spines.

Female. Smaller than the male and possessing hardly any characteristic features, except for those in the first antenna and in the mandible palp, which resemble the corresponding male appendages and which furnish sufficient salient points to make the female identifiable.

Remarks. — Smaller specimens (which can be either younger or can belong to lake populations, having a smaller mean size than river populations) bear less setae on the posterior legs (compare figs. 1 k and l which represent the seventh leg of a river inhabitant and a lake inhabitant, respectively). On the other hand, lake specimens usually possess the highest number of groups of elements on the lower margin of the peduncle segments of the first antenna. Young males have less, or are even devoid of, calceoli.

This is the only species of gammarid in the littoral zone of the great lakes south of the Alps (Lago di Como, Lugano, Garda, Maggiore). It is also the most common species in the Po river-system, although it is sometimes accompanied there by *E. ruffoi* n.sp. and/or *E. veneris* (Heller).

A detailed comparison between *E. fluminensis* and related species is given in table I. The most easily observed differences from *E. veneris* are: (1) the longer second and third peduncle segments in the first antenna; (2) the greater number of groups of elements on the lower margin of the peduncle segments in the first antenna and the greater lengths of these elements; (3) the greater number of setae in the proximal group of segment 2 of the mandible palp; (4) the lower number of setae on the peduncle and flagellum

of the second antenna; (5) the smaller length of the dorsal setae on the peduncle segments 4 and 5 of the second antenna.

The most easily observed differences from *E. pungens* (H. Milne Edwards, 1830) are: (1), (2) and (3) as for *veneris* (see above); (4) the number (three) of palmar angle spines in leg 2; (5) the less closely set ornamentation of the posterior margin of the basis in legs 5 through 7; (6) the presence of spines on the propodal sole of legs 3 and 4.

Etymology. — The proposed specific name, *fluminensis*, is derived from the Latin word *flumen*, meaning stream, river, or waterbody.

***Echinogammarus ruffoi* n.sp. Figs. 3, 4a-d.**

Material examined. —

ITALY:

1 ♂ (holotype) and more than 100 paratypes. Small brook 7 km E. of Leno (prov. Brescia), running water, full of waterweeds, 14 Apr. 1969 (ZMA Amph. 102.271).

Many specimens, brook between Leno and Manerbio (prov. Brescia), in moss on stones, 14 Apr. 1969 (Cl 8 mg/l, Ca 99.8 mg/l).

3 specimens, Fiume Tione near Villimpenta (prov. Mantova), muddy, 16 Apr. 1969.

8 specimens, brook just E. of Roncoferraro (prov. Mantova), in waterweeds, 16 Apr. 1969 (Cl 17 mg/l).

Description. — Male. Maximum length observed about 15 mm. The lateral lobes of the head (fig. 3a) are nearly pointed. The eye is very wide. No teeth or elements on the dorsum of the metasome.

In the first antenna (fig. 3b) the second peduncle segment is slightly shorter than the first, the third is between 2 and 2½ times as long as wide. These three peduncle segments are only scantily armed on the lower margin, with 2 to 3, 4 to 5, and 2 to 3 groups of short setae, respectively. The accessory flagellum is rather short, 4-segmented; the flagellum is long, 20- to 24-segmented.

The second antenna (fig. 3c) resembles that of *E. veneris* in being rather richly setose, but the number of elements participating in this setation on peduncle segments 4 and 5 is nevertheless distinctly less than in *veneris*, and the length of these elements is distinctly inferior to that found in *veneris*. Calceoli present, 6 to 8 in number. Flagellum segments armed with setules that are much shorter than those on the peduncle.

The mandible palp (fig. 3d) has an unarmed first segment. The second segment possesses only 4 or 5 short setae in the proximal group, separated by a wide gap from the 8 or 9 setae in the distal group. The distal segment does not show great differences from that of *E. fluminensis*.

The first leg (gnathopod 1) has several long setae on the lower margin of its coxal plate (fig. 3e). The propodus is rather similar to that of *E. fluminensis*. The mid-palmar spine is distinctly truncate (fig. 3f).

The second leg (gnathopod 2) has, like the first leg, a hairy lower margin of the coxal plate (fig. 3g). The propodus is rather elongate, bears usually two palmar angle spines only, and is provided with a truncate mid-palmar spine (fig. 3h).

The third leg (fig. 3i) has hardly any setae on the lower margin of the coxal

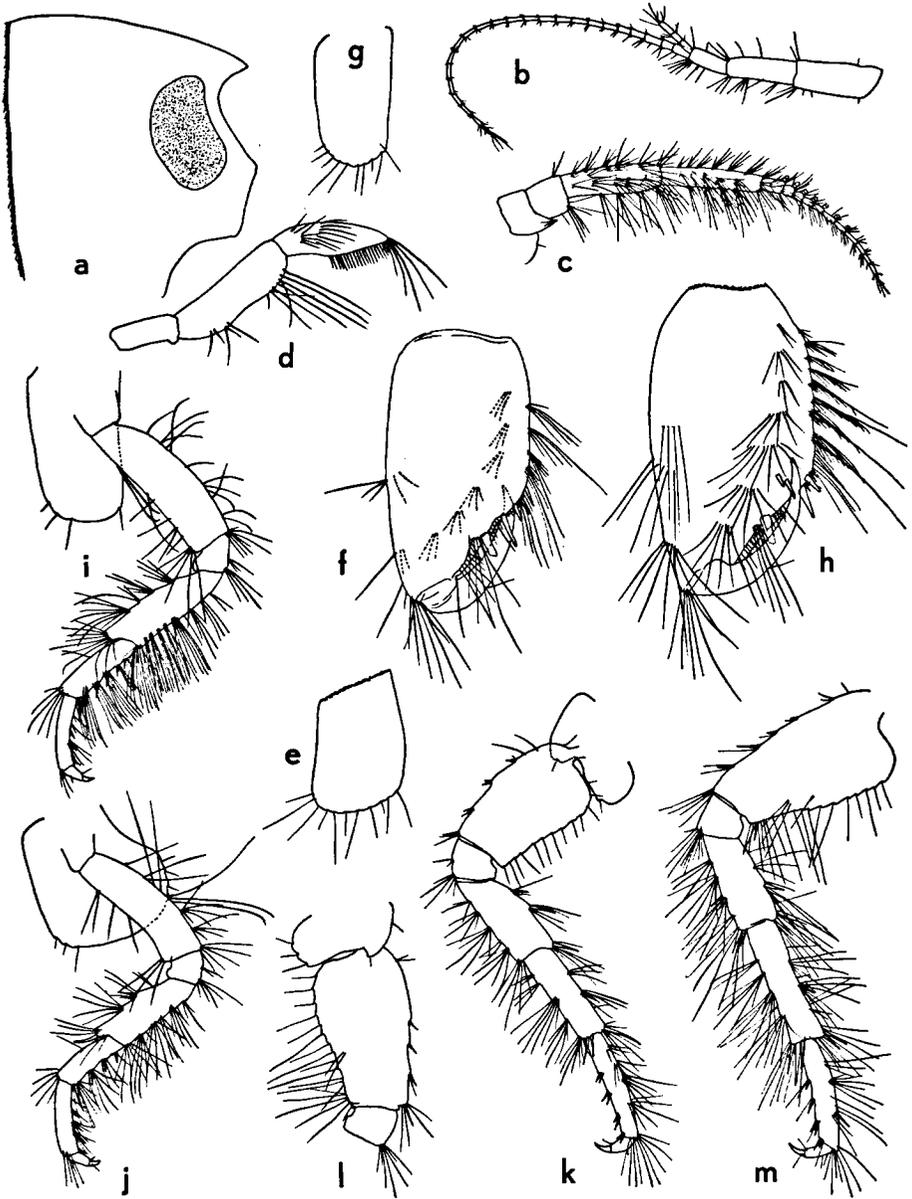


FIG. 3. *Echinogammarus ruffoi* n.sp., ♂ (from a brook E. of Leno). a, cephalic segment (scale 3); b, first antenna (scale 1); c, second antenna (scale 1); d, mandible palp (scale 2); e, first coxal plate (scale 1); f, hand of first leg (scale 2); g, second coxal plate (scale 1); h, hand of second gnathopod (scale 2); i, third leg (scale 1); j, fourth leg (scale 1); k, fifth leg (scale 1); l, proximal segments of sixth leg (scale 1); m, seventh leg (scale 1).

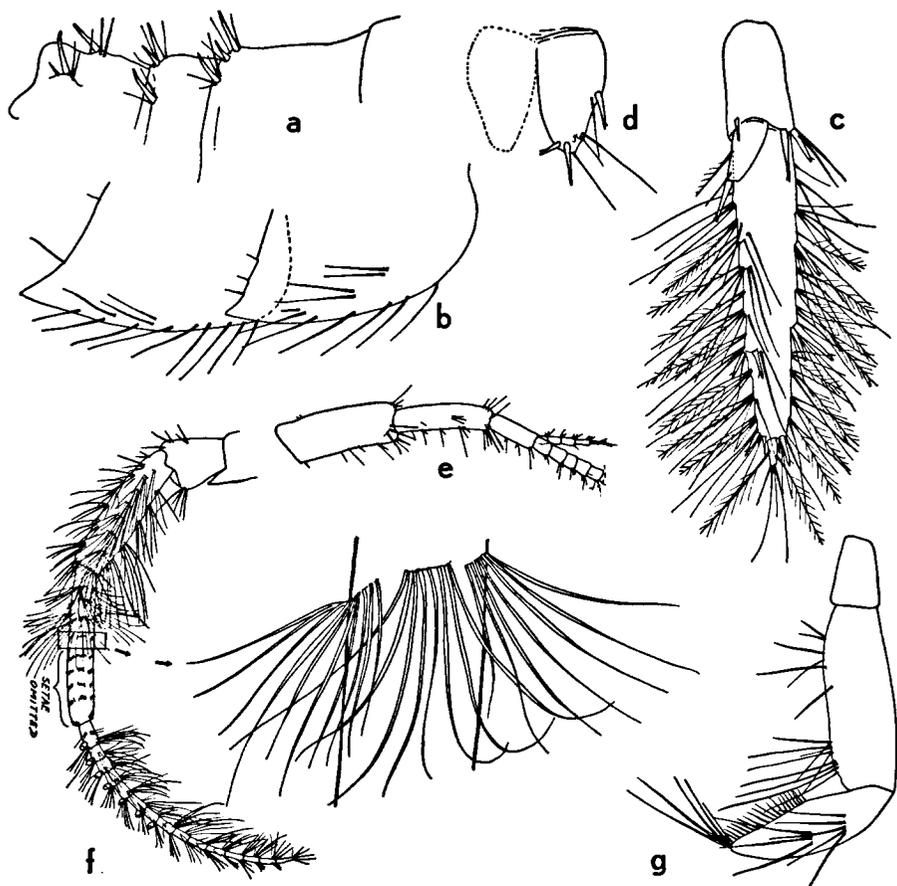


FIG. 4. a—d, *Echinogammarus ruffoi* n.sp., ♂ (from a brook E. of Leno). a, contour of the urosome, from the right (scale 3); b, second and third epimeres (scale 3); c, third uropod (scale 3); d, telson (scale 2). e—g, *Echinogammarus veneris* (Heller, 1865). ♂ (from a brook at Roncoferraro, E. of Mantova). e, proximal part of first antenna (scale 1); f, second antenna (scale 1), with enlargement of a portion of the fifth segment; g, mandible palp (scale 2).

plate, but more groups of elements on the merus (usually 5 on the anterior and 8 to 10 on the posterior margin) than in *E. fluminensis*. The propodal sole is armed with setae and spines.

The fourth leg (fig. 3j) has hardly any setae on the lower margin of the coxal plate. Here again the merus bears more groups of elements than *E. fluminensis*. The propodal sole is as in the 3rd leg.

The fifth leg (fig. 3k) has medium long setae on the posterior margin of the basis. The merus is characteristically armed: there are three groups of elements on its posterior margin, each consisting of a spine and of long setae (the latter being as long as the diameter of the merus). The posterior margin of the carpus is also armed with long setae.

The sixth leg (fig. 3l) has long setae on the posterior margin of the basis (the longest of these setae attain a length equal to the diameter of the segment carrying them).

The seventh leg (fig. 3m) has a tapering basal segment, the posterior margin of which is nearly straight in its distal part. This margin is armed with long setae (as long as the segment's diameter). The inner surface of the basis bears a few setae only. The posterior margin of the merus bears 4 or 5 groups of elements, including the terminal group; the setae in these groups are 3 times as long as the spines, and much longer than the diameter of the merus. The carpus bears usually 5 groups (including the terminal group) of elements on its posterior margin; here again, the setae are very long. Also on the propodus, one finds long setae.

The contour of the urosome (fig. 4a) shows even less pronounced dorsal elevations and saddle than in *E. fluminensis*. The dorsal spine formula is most often I-II-I; I-II-I; I-I-I. Each spine is accompanied by 2 or 3 setules that hardly overreach the spines. The epimeres 2 and 3 (fig. 4b) have pointed hind corners and setiferous lower margins; the second epimere has several setules at its posterior margin, the third one or two.

The third uropod (fig. 4c) is very characteristic in its armature. Both rami bear relatively few plumose setae (at most one plumose seta per bunch), whereas the majority of the setae is smooth.

The telson (fig. 4d) usually possesses a subbasal spine; distally, long setae accompany the spines.

Remarks. — Through the relative length and scarce armature of the peduncle segments 1 to 3 of the first antenna, as well as through the brush-like peduncle of the second antenna, the present species is reminiscent of *E. veneris* (Heller). On closer inspection, however, several important and constant differences appear to be present, the most easily observed of which are: (1) the smaller number of setae, and the reduced length of these, on the peduncle of the second antenna (compare figs. 3c and 4f); (2) the shorter setae on the flagellum of the second antenna (cf. figs. 3c and 4f); (3) the presence of only 2 palmar angle spines in leg 2; (4) the long setation of the basis in legs 5 through 7; (5) the presence of long setae on the posterior margin of the merus of leg 5; (6) the high number of groups of elements, and the great

length of the setae in these groups, on merus and carpus of leg 7; (7) the reduced number of plumose setae on the uropods.

The characters (3), (4), (5), (6), and (7), as well as the armature of the second mandible palp segment form easy distinctions from *E. fluminensis*.

From *E. pungens* (H. Milne Edwards), the new species can be distinguished by: (1) the presence of spines on the propodal sole of legs 3 and 4; (2) a richer armature of peduncle segments 4 and 5 of the second antenna; (3) the very "flat" urosome contour; (4) the reduction of the number of plumose setae on the third uropod; (5) the absence of densely set setules on the inner surface of leg 7.

Etymology. — This new species is dedicated to Dr. S. Ruffo, of the Museo Civico di Storia Naturale, Verona, in recognition of his numerous fine scientific contributions to amphipodology.

***Echinogammarus tibaldii* n.sp. Figs. 5—7.**

Material examined. —

ITALY:

1 ♂ (holotype), 24 paratypes, Fiume Garigliano (prov. Napoli), 6 Mar. 1969, coll. E Tibaldi (ZMA Amph. 102.272).

Many specimens, Riete¹), fresh channel, 11 July 1944 (BMNH).

Description. — Adult male. Maximal total length (excluding antennae) about 12 mm. Lateral head lobes truncate (fig. 5a). Metasome without keel or spines.

The first antenna (fig. 6a) is very setiferous. Long to very long setae occur on peduncle segments 2 and 3, and on flagellum segments 1 to 9. The 2nd peduncle segment is slightly shorter than the first. The 3rd peduncle segment is $\frac{2}{3}$ the length of the 2nd. Peduncle segment 2 bears 5 to 7 groups of setae on its lower margin, peduncle segment 3 has 4 to 5 groups. The setae on the basal segments of the flagellum are several times as long as the segment that carry them. The accessory flagellum is 5-segmented, the main flagellum 15- to 19-segmented.

The second antenna (fig. 5d) is also very hairy. On peduncle segment 4 as well as on segment 5, about 6 groups of very long setae are implanted on the ventral, median and dorsal surfaces of the article. The flagellum is 10-segmented and also provided with numerous long setae (more than 25 setae on the basal segment). Calceoli are usually absent²).

The mandible palp (fig. 5e) has an unarmed basal segment. The second segment is rather similar to that of *E. fluminensis*. The distal segment is

¹) The locality is written, both on the label and in the files of the British Museum (Natural History), as Riete. We suppose, however, that the town Rieti (prov. Perugia) is actually meant, since (a) we are unable to find a place named Riete in Italy, and (b) Rieti is pronounced in Italian somewhat similar as Riete in English. Mr. R. W. Ingle, of the Crustacea section of the British Museum, who kindly checked the Museum's files on this point, agrees with this interpretation (in litteris, 3 Nov. 1969).

²) A single male specimen was observed in the possession of calceoli.

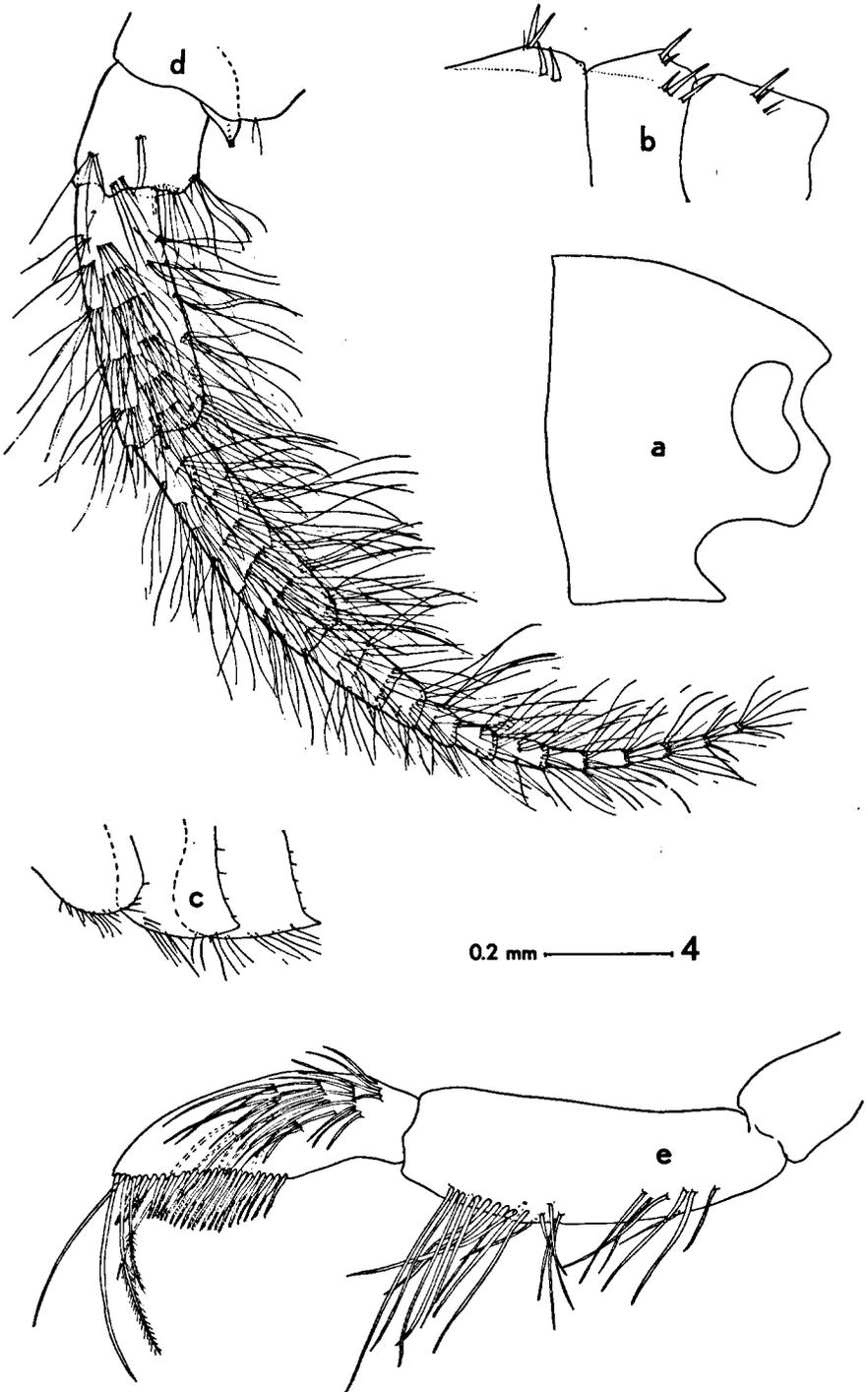


FIG. 5. *Echinogammarus tibaldii* n.sp., ♂ (from Fiume Garigliano). a, head, from the right (scale 2); b, contour of urosome, from the left (scale 2); c, epimeral plates 1 to 3 (scale 1); d, second antenna (scale 2); e, mandible palp (scale 4).

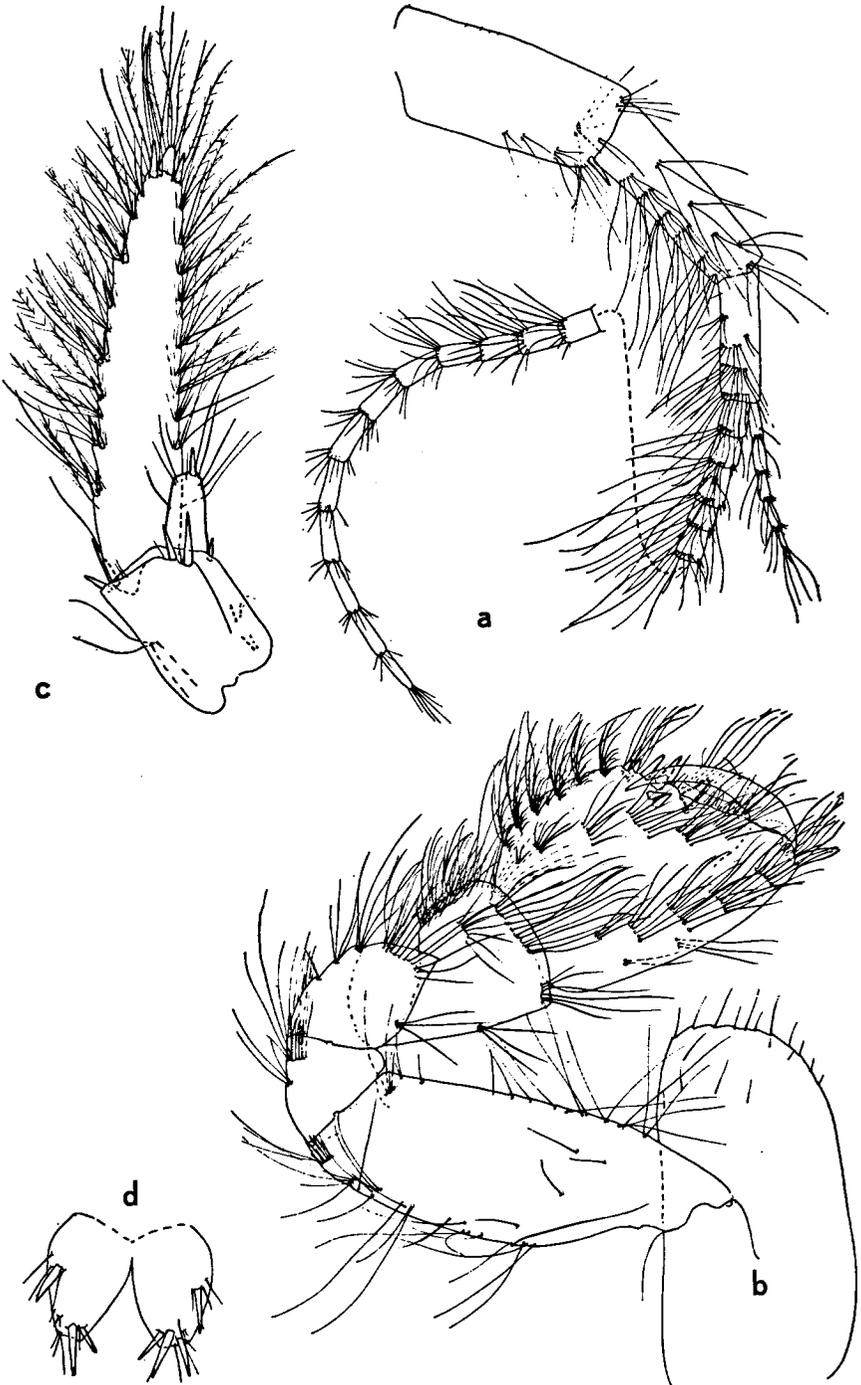


FIG. 6. *Echinogammarus tibaldii* n.sp., ♂ (from Fiume Garigliano), a, first antenna (scale 2); b, second leg (scale 2); c, third uropod (scale 2); d, telson (scale 2).

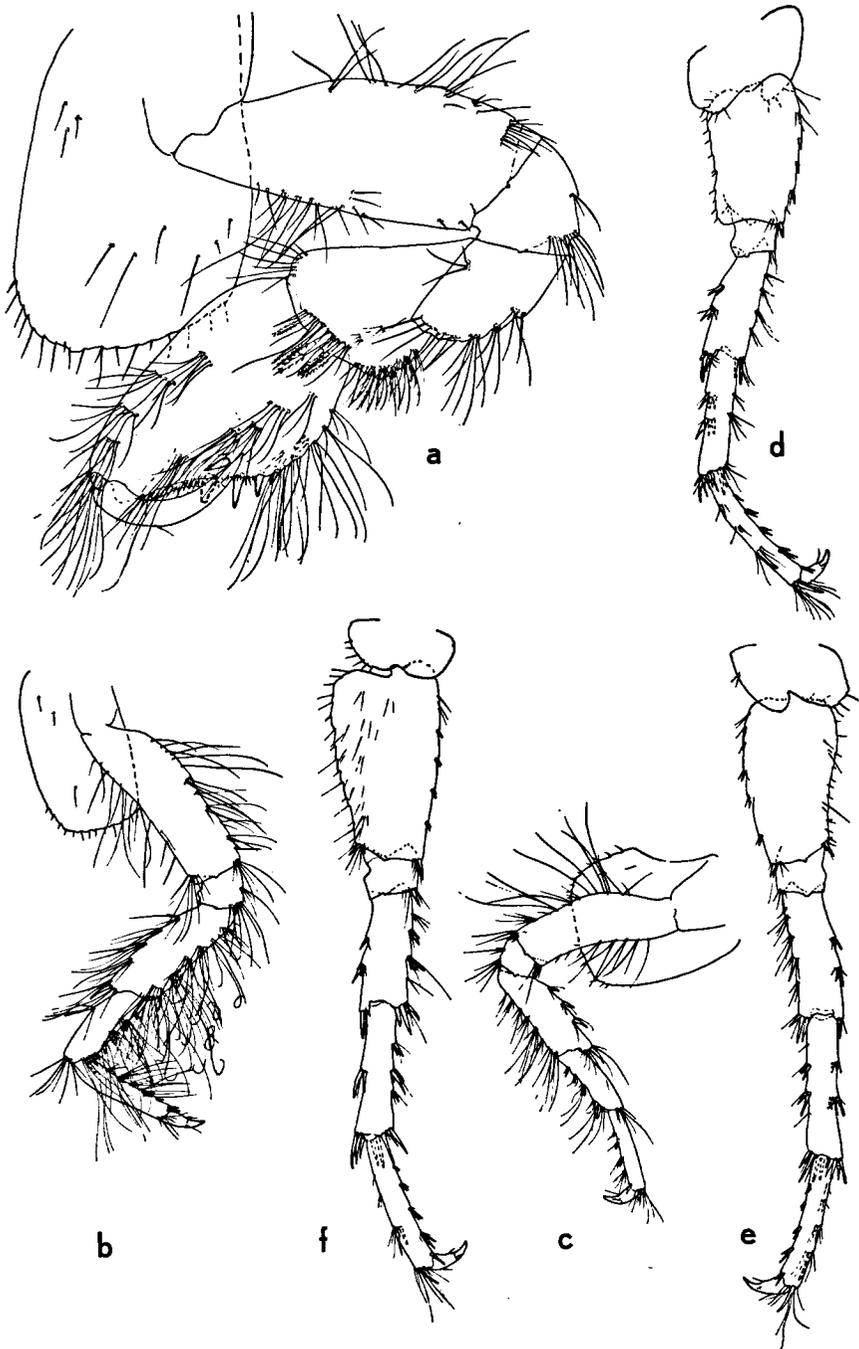


FIG. 7. *Echinogammarus tibaldii* n.sp., ♂ (from Fiume Garigliano). a, first leg (scale 2); b, third leg (scale 1); c, fourth leg (scale 1); d, fifth leg (scale 1); e, sixth leg (scale 1); f, seventh leg (scale 1).

provided with 4 terminal setae, a regular, comb-like row of ventral elements, and 4 to 5 groups of setae on the median surface.

The first leg (gnathopod 1) has a rather wide propodus (fig. 7a). There is one, more or less truncate, mid-palmar spine.

The second leg (gnathopod 2) has a wide propodus (fig. 6b) (length-width ratio about 5 : 4), provided with 4 palmar angle spines of increasing length, and with 1 mid-palmar spine.

The coxal plates of legs 1 to 4 are provided with short setae on their ventral margin.

Leg 3 (fig. 7b) has curved, and usually also some curled, setae on the posterior margin of the merus. The anterior margin of the merus bears 5 groups of elements (including the terminal group). The propodal sole is armed with spines and setae.

Leg 4 (fig. 7c) possesses 4 groups of elements (including the terminal group) on the anterior margin of the merus. As in leg 3, the propodal sole bears spines and setae

Leg 5 (fig. 7d) has a rectangular basis, the posterior margin of which is armed with short setules, the anterior margin chiefly with spinules. Merus, carpus, and propodus are slender, spiniferous and little setose.

Leg 6 (fig. 7e) has a tapering basal segment, armed posteriorly with short, rather closely set setules. In leg 7 (fig. 7f) such short setules are rather numerous also on the inner surface of the basis. Merus, carpus, and propodus are slender. The spines on the posterior margin of the merus and carpus are short, the setae implanted in between these spines are still shorter.

Urosome segments 1 and 2 have distinctly raised dorsal elevations, that are laterally compressed (fig. 5b). Each urosome segment has a rather scanty armature, usually 1 to 2 (rarely 3) spines in each group. A few, very short setules, are implanted in between the spines.

The epimeres (fig. 5c) has long setae on their lower margin. Epimere 2 has a slightly pointed, epimere 3 a more strongly pointed backcorner. The posterior margin of epimeres 2 and 3 bears several minute setules.

The telson (fig. 6d) is armed with the usual spines; the accompanying setae are about as long as these spines.

The third uropod (fig. 6c) has a long, 2-segmented exopod and a short endopod. The exopod is armed with spines and setae; a considerable part of the latter are unfeathered.

Remarks. — Through the very hairy second antenna, this new species could be mistaken for *E. veneris*. As a matter of fact, in Stock's revision of the *pungens*-group (1938 : 34) one sample listed under *E. veneris* (from Riete, Italy), actually proved to belong to this species rather than to *veneris*.

E. tibaldii is most easily distinguished from *E. veneris* by the following characters: (1) the very hairy first antenna; (2) the much longer 3rd peduncle segment in the first antenna; (3) the short spines and still shorter setae on the posterior margin of merus and carpus in legs 6 and 7; (4) the short setae (shorter than the spines) on the dorsal side of the urosome; (5) the short setae

on the telson. Moreover, in *E. tibaldii* the male second antenna usually lacks calceoli, whereas these are present in *E. veneris*.

Etymology. — This new species is dedicated to Dr. E. Tibaldi, of the Zoological Laboratory of the University of Milano, who was kind enough to present us a number of specimens of this species for description.

REFERENCE

STOCK, J. H.

- 1968 A revision of the European species of the *Echinogammarus pungens*-group (Crustacea, Amphipoda). — *Beaufortia*, **16** (211): 13—78, figs. 1—35.

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