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THE *GAMMARUS PULEX*-GROUP IN ITALY (CRUSTACEA, AMPHIPODA)

(A study based on material from the
Museo Civico di Storia Naturale, Verona)

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ABSTRACT

A historical review is given of the literature on Italian members of the genus *Gammarus*. Only three *Gammarus* species were known with certainty from Italy, viz *G. fossarum* Koch, 1836, *G. lacustris* G.O. Sars, 1863, and *G.* cf. *balcanicus* Schäferna, 1922. *G. fossarum* is widely distributed in the northern part of Italy. Near the Yugoslavian border a member of the *G. balcanicus*-group sometimes coexists with this species. *G. lacustris* seems to be confined to mountain lakes. Some doubt remains about the identity of *G. fontinalis* A. Costa, 1883.

During the present study a new species was found, *G. italicus*, inhabiting a restricted area in the central part of Italy and the northwestern part of Sardinia.

INTRODUCTION

In 1973 Prof.Dr. S. Ruffo of the Museo Civico di Storia Naturale, Verona, Italy, asked us to re-examine the material deposited in the collections of the M.C.S.N. under the names *G. fossarum* Koch, 1836, or *G. pulex* (Linnaeus, 1758), since some doubt had arisen about the correctness of the identification of this material after the publications of Goedmakers (1972) and Pinkster (1972).

For a better understanding of the confused taxonomic literature on the genus *Gammarus* in Italy, a brief historical introduction is necessary.

In former times many species were referred to the genus *Gammarus* s.l. which are nowadays generally attributed to distinct genera, like *Gammarus* s. str., *Echinogammarus*, and *Chaetogammarus*. The subdivision into lower taxa was often based on characters now considered variable and far from characteristic. These changed ideas have resulted

in great difficulties in interpreting older works, like those of Garbini (1894 and 1895). This author based his subdivision on the presence and shape of the eyes and we can only guess what he meant by his so-called species (see also Ruffo, 1937).

The artificial distinctions between the species *G. pulex* and *G. fluviatilis* pose another problem. Although Gervais (1835) in our opinion solved the problem quite well in discriminating *G. pulex* from *G. roeseli* Gervais, 1835 and discarding the confused name *G. fluviatilis* (the first characterized by a smooth metasome, the second by a spiny metasome), the chaos persisted. This was mainly due to the fact that most authors studied material from their own region only and did not illustrate what they meant by certain descriptive characterizations. Therefore a species having a spiny metasome when compared with other species in one country, could be identical with a species having a smooth metasome in another country. Thus Costa (1883) found two species on Sardinia: one with a smooth and one with a spiny metasome. He described the one with a smooth metasome as a new species *G. fontinalis*, although with his knowledge of the literature it would have been more logical if he would have called it *G. pulex*. At any rate, he did not mention any character to distinguish it from *G. pulex* in the sense of Gervais (1835) (see also Stebbing, 1906: 513). Moreover, he cited Gervais wrongly in using the name *G. fluviatilis* for the spiny species instead of *G. roeseli* as he should have done (see Costa, 1883: 107). On account of our present knowledge of the fauna of Sardinia (see G.S. Karaman, 1974) we may now assume that one of the present species of *Echinogammarus* was meant by his spiny *G. fluviatilis*. The smooth species which he named *G. fontinalis* is possibly identical with our *G. italicus* n. sp. described in the present paper, but we cannot be sure about this since his material is not available any more.

The question of the still more sophisticated distinctions between *G. pulex* and *G. fossarum* within the *Gammarus pulex*-group *) originates from the work of Chevreux & De Guerne (1892), who used the names *G. pulex*, and *G. delebecquei* for *fossarum*. After that there remained a lot of confusion on this matter until recently (see Pinkster, 1972, and Goedmakers, 1972).

Let us return to the problem of the Italian gammarids. Ruffo (1937) mentioned *G. neretvanus* (S. Karaman, 1931a) and *G. pulex danubialis* (S. Karaman, 1931b) as members of the genus *Gammarus* in northern Italy. The first species must be considered synonymous with *G. balcanicus* Schäferna, 1922 s.l. *G. p. danubialis* and its f. *subterranea* is synonymous with *G. fossarum*, as Ruffo remarked already in a foot-note to his 1937 publication.

The other *Gammarus* species mentioned by Ruffo: *G. olivii* H. Milne Edwards, 1830, and *G. pungens* H. Milne Edwards, 1840, are now considered to belong to the genera *Chaetogammarus* and *Echinogammarus*, respectively (see Stock, 1968). *G. fluviatilis* Roesel (see Garbini, 1895) or *G. pulex* (Linnaeus, 1758) as Garbini (1904) called it later on, must be considered according to Ruffo (1937) a member of the *Echinogammarus pungens*-group. We can only partly agree with this view, since in our opinion the *G. fluviatilis* reported by Garbini from mountainous regions in northern Italy could be our *G. fossarum* as well. Also we are of the opinion that *G. fluviatilis* var. *spinosus* Garbini, 1894, is synonymous with *G. fossarum*. (*G. fluviatilis* var. *manophthalmus* Garbini, 1894, is probably a member of the genus *Niphargus*; see also Stebbing, 1906: 409.)

In 1937, Schellenberg reported one locality of *G. lacustris* in the Dolomites. Ruffo (1951) was able to name four other lakes containing *G. lacustris*, and thereby the distributional area of this species was extended to the Ligurian Appenines, northeast of Genoa. Cecchini (1928) mentions this species from this same region, under the name of *G. pulex*.

Summarizing: At the start of this study, as far as could be retraced from literature only three representatives of the genus *Gammarus* were known from Italy: *G. fossarum*, *G.* cf. *balcanicus*, and *G. lacustris*. All three species seemed to be restricted to the northern provinces. During the examination of the material preserved in the Museo Civico di Storia Naturale we did not only find these three species but also a fourth, presumably new species. This species, which is described in the present paper, is confined to a

*) For the sake of convenience the freshwater species of the genus *Gammarus* are divided into three artificial groups viz the *G. roeseli*-group, the *G. pulex*-group, and the *G. balcanicus*-group (see Pinkster, 1972; Karaman & Pinkster, in press).

restricted area in central Italy and the north-western part of Sardinia.

The new species, *G. italicus*, might possibly be synonymous with *G. fontinalis* A. Costa, 1883, especially since the localities mentioned by Costa lie within the range of *G. italicus*. However, since we were not able to retrace the material studied by Costa, no certainty about the identity of *fontinalis* could be acquired, so we preferred to establish a new species for it.

DESCRIPTION

Gammarus italicus n. sp.
(Figs. 1, 2)

Refs.- ?*Gammarus fontinalis* Costa, 1883: 81-82, 106-107; 1884: 340; Della Valle, 1893: 766; Stebbing, 1906: 513 (all these references are doubtful).

Material examined.-

Reg. Umbria:
- Borgo Cerreto (Valle della Nera - Spoleto); IX-1955 (many specimens).
- Marcite di Norcia; 18-VI-1976, Ruffo leg. (many specimens).

Reg. Marche:
- Fiume Nera near Castelsantangelo; 18-VI-1976, Ruffo leg. (2 specimens).

Reg. Abruzzi:
- Sagittaris stat. 18, Scanno, spring near Piano; VIII-1940, Pomini leg. (16 specimens).
- Val Fondillo, Parco Nazionale dell'Abruzzi; 24-VII-1957 (13 specimens).
- Parco Naz., le Prata di Lecce, 1540 m; 4-V-1953, C. Consiglio leg. (1 specimen).
- Pescasseroli, 1167 m, F. Formone Morte; 2-V-1953, C. Consiglio leg. (27 specimens).
- Pescasseroli; 2-VII-1952, C. Consiglio leg. (12 specimens).
- Fiume La Foce, Gole di Celano; 25-IV-1957, C. Consiglio leg. (1 specimen).
- Spring south of Campo Felice; 28-VI-1971, Viagnò leg. (3 specimens).
- Capo Pescara, 23-VIII-1955 (1 specimen).
- Pizzo di Moscio, 1700-2100 m (Monti della Laga); 25-VII-1968; Bruno leg. (16 specimens).
- Cava Mandrilli, P.N. Abruzzi, Cicerana; 23-VIII-1973, Nariglio and Da Vigna leg. (6 specimens).

Reg. Lazio:
- Environments of Roviano; 22-IX-1952, C. Consiglio leg. (together with *Echinogammarus* spec.) (4 specimens).
- Environments of Roviano, 600 m; 30-V-1952, F. Hartig leg. (24 specimens).
- Spring La Tota, M. Lepini; IV-1968, Da Vigna leg. (3 specimens).
- Filettino; 1-XI-1968, C. Consiglio leg. (3 specimens).
- Fiume Simbruvio above Vallepietra, 900 m; 29-III-1964, Sbordoni leg. (8 specimens).

Reg. Campania:
- Spring Capo Volturno (Rochette al Volturno); 31-VII-1964, Gervasio leg. (16 specimens).
- Do., 15-IX-1964, Gervasio leg. (11 specimens).
- Do., 8-XI-1964, Palminteri leg. (14 + 30 specimens).
- Do., 24-XI-1964, Gervasio leg. (many specimens).
- Do., 22-XII-1964, Gervasio leg. (many specimens).
- Well near Lete river (Matese) 1 km upstream of Letino; 19-IX-1967, Giusti-Minelli leg. (many specimens).
- Gari Liri, Garigliano; 1-III-1968 (2 specimens).

Reg. Sardegna:
- Torralba; 31-V-1964, Moscardini leg. (many specimens).
- Sassari, Torralba; 22-V-1974, Osella leg. (25 specimens).
- Bara, Macomer (Nuoro), between mosses in the brook; 22-V-1973, Osella leg. (14 specimens).
- Pedru Mannu, 8 km from Macomer - Nuoro; 22-V-1974, Osella leg. (many specimens).
- Rio Mannu, between Macomer and Pozzo Maggiore (Nuoro); 22-V-1974, Osella leg. (3 specimens).
- Stream near Nuraghi Torralba; VII-1968, Krapp leg. (many specimens).
- Brook near the Nuraghe di S. Antino; 24-IV-1969, Giusti leg. (17 specimens).
- Origin of a stream near Ittiri; 2-VII-1968, Krapp leg. (25 specimens).
- Cave with resurgence of Monte Majore (Thiesi); 13-VIII-1974, Grafitti leg. (3 specimens).

Type locality.- Italy, Sardinia, Torralba. The ♂ holotype and many paratypes have been deposited in the collection of the Museo Civico di Storia

Naturale, Verona. Twenty paratypes have been deposited in the Zoölogisch Museum Amsterdam (ZMA), (Amph. No. 105.477).

Diagnosis.- A medium large species making a rather robust impression because of the relatively short antennae. Pereiopods 5 to 7 are armed with spines only. The dorsal surface of meta- and urosome is flat.

Description, ♂.- Maximum length observed 18 mm. The metasome segments are unarmed. The urosome segments have no dorsal excavations or elevations and are armed with a dorsomedian and a dorsolateral group of elements on each side. These groups usually are a mixture of spines and short setae which can be replaced by each other.

The lateral cephalic lobes (fig. 1A) are usually rounded. The eyes are relatively small, ovoid, shorter than the diameter of the peduncle of the first antenna.

The first antenna is short, about 0.4 of the total body length. Peduncle segment 2 is about 0.7 of segment 1; peduncle segment 3 is about 0.7 of segment 2 (fig. 2A). The main and accessory flagellum are scarcely armed having 18 to 25 and 2 to 4 segments, respectively.

The slender gland cone of the second antenna (fig. 2B) attains the distal end of the third peduncle segment. Peduncle segments 4 and 5 are almost equal in length. Tufts of setae are implanted in three longitudinal rows on these segments. In every row 3 or 4 tufts are found. In young animals the tufts in the various rows are separated; in older animals tufts from different rows tend to fuse into each other, thus forming a kind of brush that surrounds the peduncular segments. The length of the setae implanted in these tufts, increases from 1 to 1.5 X the diameter of the segment towards the distal end. The 8- to 13-segmented flagellum is never flattened, sparsely setose, the setae being as long as the diameter of peduncle segment 5. Calceoli are often present in the first 4 to 6 segments.

The mandibular palp has an unarmed first segment. The third segment is armed with a regular row of 20 to 26 D-setae, 4 or 5 E-setae, 1 group of A-setae and 1 or 2 groups of B-setae (fig. 1B) (for terminology see G. Karaman, 1970).

The propodus of the first gnathopod (fig. 1C) is pyriform, the palm being oblique and set with a medial palmar spine. A strong palmar angle spine and many smaller spines are implanted along the posterior margin and the inner surface of the propodus. The merus, carpus and propodus bear (groups of) long, sometimes curved, setae.

The propodus of the second gnathopod (fig. 1D) has about the same size as in the first gnathopod. Its palm, however, is almost transverse. A strong medial palmar spine and 3 to 5 palmar angle spines are present. Many setae, variable in length and often curved are implanted on merus, carpus and propodus of this gnathopod.

Segments 4 to 6 of pereiopods 3 and 4 (figs. 1E and 1F) bear groups of long, often curved setae varying in length from 1.5 to 3 X as long as the diameter of the segments. Coxal plates 1 to 4 have rounded inferior corners.

Pereiopods 5 to 7 (figs. 1G, 1H, and 1I) have a relatively short basis, varying from almost rectangular in P5 to 1.5 X as long as wide in P7. The distal portion of the basis is always much wider than the proximal portion of the ischium, thus forming a backward protruding lobe. The interior surface of the basis is unarmed. The armature of segments 3 to 6 consists of a varying number of spines or groups of spines, sometimes intermixed with short setae. The dactyli of all pereiopods are moderately slender.

The first epimeral plate (fig. 1A) has an almost rectangular posteroinferior corner. In the second and third epimeres these corners vary from moderately to sharply pointed. Their inferior margins are set with small spines intermixed with few very short setae.

The third uropod (fig. 2C) is relatively short. Its endopod is 60 to 75% of the exopod. Plumose setae are found on the inner and outer margins of both endo- and exopod.

The telson lobes (figs. 2D and 1A) overreach the pedunculus of the third uropod. Many (groups of) spines and setae are implanted along the margins. Moreover, groups of spines and setae are implanted on the dorsal surface of the telson lobes. Usually these setae, more in particular the terminal ones are much longer than the spines.

♀.- Differs from ♂ in: (1) a smaller propodus in both gnathopods; (2) a smaller third uropod (fig. 2F); (3) shorter and wider telson lobes (fig. 2G);

(4) a shorter second antenna (fig. 2E) with slightly longer setation; (5) absence of calceoli (fig. 2E).

Variability.- As in *G. fossarum* variability was observed in the presence or absence of calceoli on antenna 2 (see Goedmakers, 1972). Usually, calceoli are present but in some localities they are absent in most specimens. The length and number of setae on the peduncle of both antenna 1 and 2 is variable (compare figs. 2B and 2I, 2A and 2H). In one sample from Campo Sotto Felice an adult male was found with a much less setose antenna 2 (see fig. 2L). Since we only had one specimen we cannot be sure if the differences observed in uropod 3 and telson of the same specimen (see fig. 2M and 2N) are due to variability or if we have to do with another species. The other two animals in the sample were "normal" *italicus*. Considerable variability was observed in the relative length of the inner ramus in uropod 3 as well as in the armature of uropod 3 and the telson lobes (see figs. 2C, J, and M, 2D, K, and N).

Distribution.- This species is widely distributed in the central part of Italy and the northwestern part of Sardinia (see fig. 3).

Remarks and affinities.- Most characters of this species are more or less intermediate between *G. p. pulex* and *G. fossarum* as is the case in *G. wautieri* Roux, 1967. However, it differs from the latter species in its shorter antenna, the longer and more numerous setation on peduncle segments 4 and 5 of antenna 2 and the shorter and wider basal segments of P5 and P7.

Ecology.- In spite of a rich material, little is known of the ecology of this species except that it lives in wells and upper courses of small streams. The colour of live specimens is unknown.

Gammarus fossarum Koch, 1836

Refs. for Italy only.-
Cancer pulex (part.); Pollini, 1816: 22-23*).
Gammarus fluviatilis (part.); Garbini, 1894: 4.
Gammarus fluviatilis var. d'Emmerin Garbini, 1894: 4.
Gammarus fluviatilis var. *spinosus* Garbini, 1895: 29-31.
Gammarus pulex; Garbini, 1904: 966.
Rivulogammarus pulex danubialis S. Karaman, 1931b: 102-103.
Rivulogammarus pulex danubialis forma *subterranea* S. Karaman, 1931b: 103.
Gammarus pulex danubialis; Ruffo, 1937: 47-51.
Gammarus pulex danubialis forma *subterranea*; Ruffo, 1937: 51.
Gammarus (*Rivulogammarus*) *pulex fossarum*; Schellenberg, 1937: 503-505.

*) We cannot be sure about this reference, because this author gave the genera *Gammarus* and *Orchestia* the same name in this publication (see Garbini, 1895). We cite it because it is the oldest reference we could find for Italy.

Material examined.-
Reg. Veneto, Prov. Verona:
- Bolca, 30-V-1937, Recchio leg. (many specimens).
- Bolca (Vestenanuova), cave without name; 26-X-1971, Corradi leg. (8 specimens).
- Brook Covolo dell'Acqua (Velo Veronese); 18-VII-1936, Ruffo leg. (many specimens).
- do., VII-1963, Palminteri leg. (many specimens).
- Costeggiola; VII-1936, Ruffo leg. (5 specimens).
- Vaio del Cerè; 21-VII-1946, Ruffo leg. (many specimens, 3 precopulations).
- Basalovo (Grezzana); 1-X-1961, Pasa leg. (12 specimens).
- Vaio de la Sermassa (Grezzana); 21-V-1967, Mingione leg. (12 specimens).
- Progno delle Pozze (Peri); 1-X-1967, Mingione leg. (10 specimens).
- Vaio Strossina , between Stallavena and Alcenago; 8-X-1967, Mingione leg. (many specimens).
- Vaio del Paradiso (Grezzana); 8-XII-1967 (4 specimens); 19-III-1968, Mingione leg. (2 specimens).
- Rovinal near Breonio, 900 m; VIII-1968, Osella-Sorbini leg. (8 specimens).
- Fast flowing part of the mouth of the Coalo della Sbolsa (Breonio-Fosse); IX-1968, Fridini leg. (33 specimens).
- Vaio della Marciora (Lessini); 13-X-1968, Mingione leg. (3 specimens).
- Torrente del Ponte di Veja (S. Anna d'Alfaedo); 6-V-1971, Osella leg. (3 specimens).
- Vaio dei Progni (Fumane); 11-V-1972, Mingione leg. (28 specimens, 1 precopulation).
- Val Sorda; 22-VIII-1938, Recchia leg. (29 specimens).
- Spring near the Buso de la Spurga (Peri);

29-IX-1946, Ruffo leg. (26 specimens).
- Case Vecie, 500 m (Grezzana); 16-V-1970, Osella leg. (4 specimens).
- Roverè Veronese, 800 m, brook in the Mufin wood; 29-VII-1963, Palminteri leg. (26 specimens).
- Mte Baldo, last station of funicular railway Malcesine, 1800 m; 13-VIII-1973, Osella leg. (1 specimen).

Reg. Veneto, Prov. Treviso:
- Springs of Meschio (Vittorio Veneto); IX-1947, Pasa leg. (20 specimens).
- Cave Andron (Conegliano); Zecchini leg. (3 specimens).
- Torrente Soligo; 21-III-1967, Minelli leg. (7 specimens).
- Castelcucco (Colli di Asolo); 10-V-1964, (9 specimens).
- Cison di V.-S. Daniele; 21-IX-1971, (together with *G.* cf. *balcanicus*) (9 specimens).

Reg. Veneto, Prov. Vicenza:
- Pederiva (Lonigo); 19-III-1972, Zanetti - Daccordi leg. (1 specimen).
- Miniera: Campi Cerealto; 17-IV-1954, Visona leg. (8 specimens).

Reg. Veneto, Prov. Belluno:
- V. Canzioi, 600 m (brook in the wood); 10-IX-1972, Marcuzzi leg. (many specimens).

Reg. Friuli - Venezia Giulia, Prov. Pordenone:
- Fiume Noncello; 17-V-1959, (many specimens).

Reg. Friuli - Venezia Giulia, Prov. Trieste:
- Cave Trebiciano, N 17 V.G., Fiume Timavo; 4-IX-1954, Conei - Biancheri leg. (1 specimen).
- do., 4-IX-1954, Coreci leg. (3 specimens).
- Trebiciano; 21-VIII-1936, D'Anona leg. (12 specimens).

Reg. Friuli - Venezia Giulia, Prov. Udine:
- Gerchia, Mainarie del Puint; 5-X-1955, Buccia-relli leg. (5 specimens).
- Cave of Preslento (Cividale) anterior part of brook; 15-VIII-1929, (together with *G.* cf. *balcanicus*) (4 specimens).

Reg. Venezia Tridentina, Prov. Bolzano:
- Colle Isarco (Brennero), brook near Castello, road Q 990; 13-VII-1959, Saufilippo leg. (many specimens).

Remarks.- *G. fossarum* differs from *G. italicus* in the following characters: (1) the first antenna, which is about half as long as the body of the animal; (2) the setation along the inferior margin of peduncle segments 4 and 5, which is more numerous, all setae being equally long; (3) the endopod of the third uropod, which is about half as long as the exopod; (4) the exterior margin of the exopod of Ur. 3, bearing simple setae only (sometimes, in very old males only, some plumose setae may be found).

Distribution.- This species is widely distributed in the northern part of Italy (see fig. 3).

Gammarus lacustris G.O. Sars, 1863

Refs. for Italy only.-
Gammarus pulex; Cecchini, 1928: 6.
Gammarus (*Rivulogammarus*) *lacustris*; Schellenberg, 1937: 494; Ruffo, 1951: 1-8.

Remarks.- The characters in which this species differs from *G. italicus* are: (1) the peduncular segments 4 and 5 of the second antenna, which are armed with short setae only; (2) the dactylus of legs 1 to 7, which is very slender; (3) the basis of legs 5 to 7, which is elongate; (4) the posteroinferior corner of the second and third epimeral plates, which are always sharply pointed.

Distribution.- See introduction.

Gammarus cf. *balcanicus* Schäferna, 1922

Refs. for Italy only.-
Gammarus neretvanus; Ruffo, 1937: 46-47.
Gammarus fluviatilis (part.); Garbini, 1894: 4.

Material examined.-

Reg. Veneto, Prov. Treviso:
- Cison di V.-S. Daniele; 21-IX-1971, (together with *G. fossarum*) (5 specimens).
- Nervesa del Montello; VII-1941, (together with *Echinogammarus* spec.) (7 specimens).

Reg. Friuli - Venezia Giulia, Prov. Udine:
- Cave of Preslento (Cividale) brook, anterior part; 15-VIII-1929, (together with *G. fossarum*) (8 specimens).

Reg. Lombardia:
- Spring near Cà Novelli, Val Imagna; VIII-1972, Pezzoli leg. (7 specimens).

Remarks.- Although not belonging to the *G. pulex*-group, we nevertheless included *G. balcanicus* in this descriptive part because it was

found together with *G. fossarum* in one sample; and for non-specialists these species are not always easy to separate.

The *G. balcanicus*-group differs from the *G. pulex*-group in having the exterior margin of the third uropod armed with spines only.

Distribution.- See introduction.

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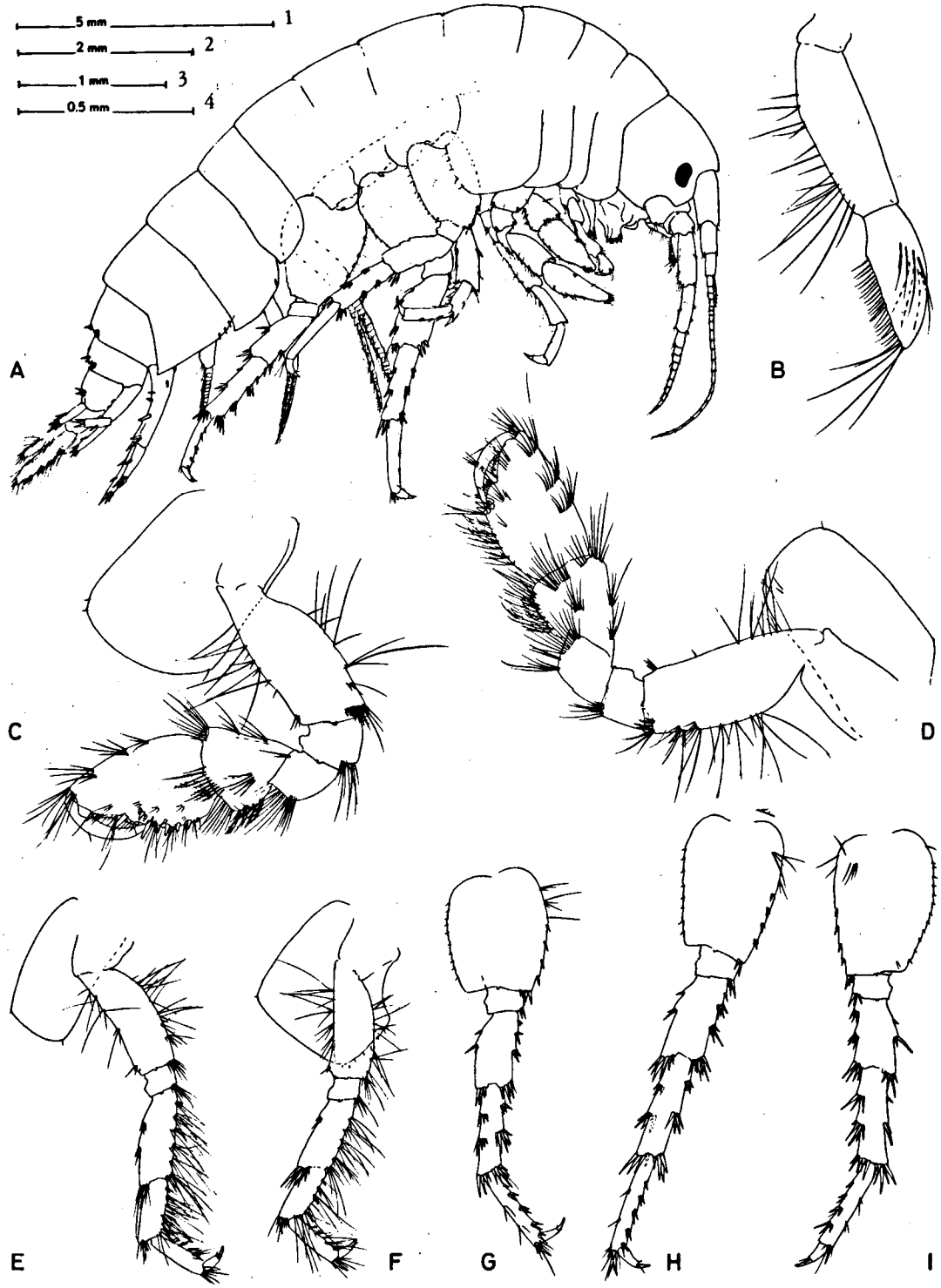

Fig. 1. *Gammarus italicus* n. sp.
♂, 17 mm, from Torralba, Sardinia. A, habitus (scale 1); B, mandible palp (4); C, first gnathopod (3): D, second gnathopod (3); E, third pereiopod (2); F, fourth pereiopod (2); G, fifth pereiopod (2); H, sixth pereiopod (2); I, seventh pereiopod (2).

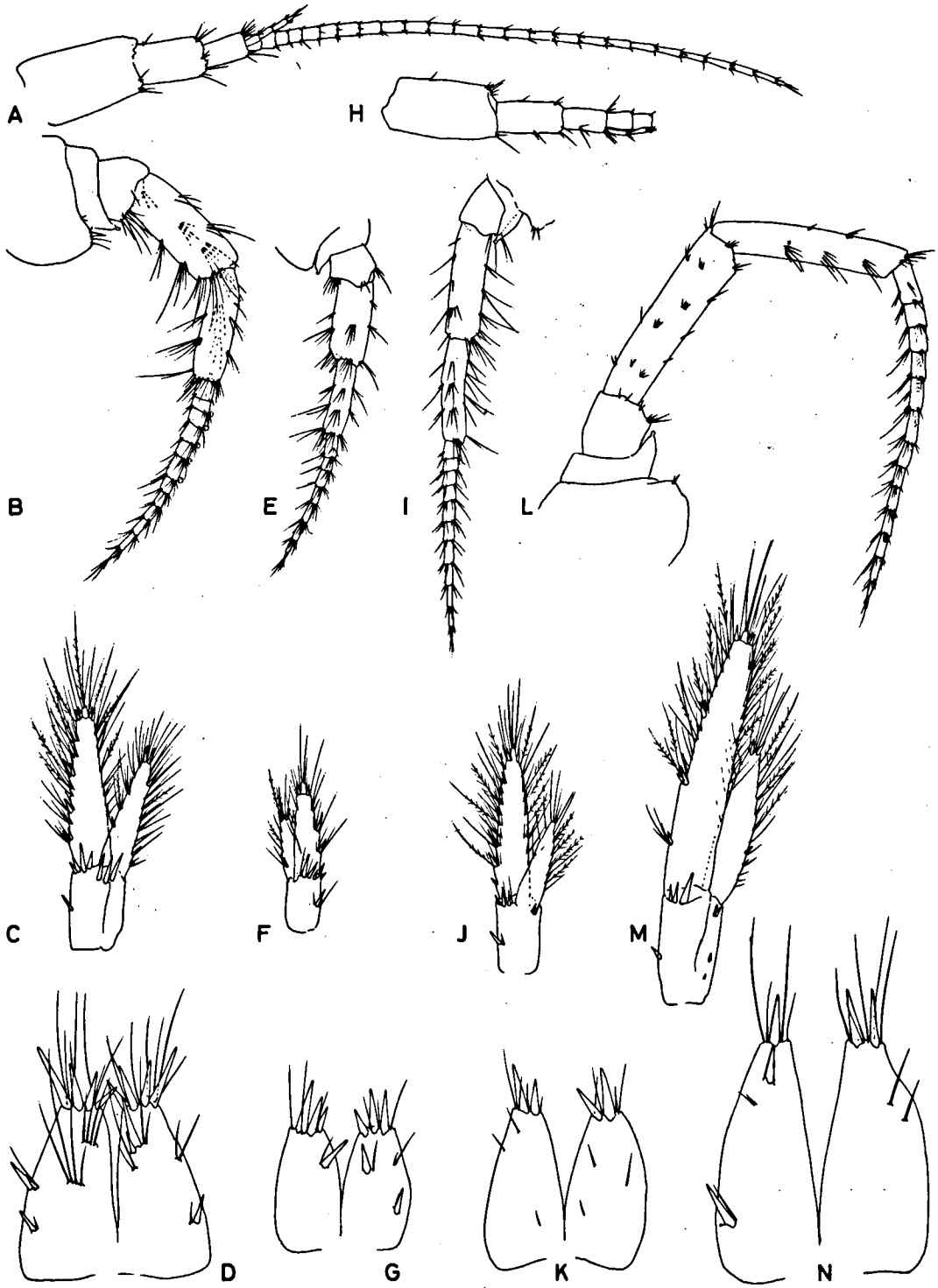

Fig. 2. *Gammarus italicus* n. sp.

A-D, ♂, 17 mm, from Torralba, Sardinia. A, first antenna (3); B, second antenna (3); C, third uropod (3); D, telson (4).

E-G, ♀, 12 mm, from Torralba, Sardinia. E, second antenna (3); F, third uropod (3); G, telson (4).

H-K, ♂, 15 mm, from the Cava Mandrilli, Reg. Abruzzi. H, peduncle of first antenna (3); I, second antenna (3); J, third uropod (3); K, telson (4).

L-N, ♂, 18 mm, from a spring south of Campo Felice, Reg. Abruzzi. L, second antenna (3); M, third uropod (3); N, telson (4).

Fig. 3. The distribution of *Gammarus italicus* n. sp., and *Gammarus fossarum* in Italy.