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MEMBERS OF THE ECHINOGAMMARUS SIMONI-GROUP AND THE GENUS EULIMNOGAMMARUS (CRUSTACEA-AMPHIPODA) FROM THE IBERIAN PENINSULA AND NORTH AFRICA, WITH DESCRIPTION OF A NEW SPECIES

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ABSTRACT

Systematic sampling proved that members of the Echinogammarus simoni-group are the dominant freshwater amphipods in the southern half of the Iberian peninsula. It became clear, that the presence (as recorded in literature) of E. simoni in the system of the river Duero was due to confusion with members of the genus Eulimnogammarus. The systematical position of the simoni-group within the genus Echinogammarus is discussed and comparative descriptions of all the members of this group are given, alongwith a key for their identification. Where possible, notes are given on the variability and ecology of the different species.

INTRODUCTION

In order to complete our very incomplete knowledge of the amphipod fauna of the Iberian peninsula, systematic sampling in nearly all drainage systems was carried out during the summers of 1969 and 1970. Although in many of the localities visited, especially in the southernmost parts of Spain and Portugal, no amphipods were found (see Pinkster, 1971), it became quite clear, that the amphipod fauna of this area is much richer than was previously known. So, the genus Eulimnogammarus, which until recently was only known from the Baikal district (Stock, 1969; Pinkster & Stock, 1970) proved to be widely distributed in the central part of Spain, and the North-African species Gammarus gauthieri Karaman, 1935, was found in several more or less isolated areas all over Spain (Pinkster, 1971).

Moreover, it became clear that Spanish records of Echinogammarus berilloni do not apply to one species, but in reality are an indication of a group of closely related forms, with a rather extensive distribution in the northern half of the peninsula (Pinkster, 1969, and in preparation). In the southern half of the peninsula, the E. berilloni-group appears to be replaced by forms related to the African Echinogammarus simoni (Chevreux, 1894). Margalef, 1956, recorded

this species from several places in Spain, including the system of the Duero, but during this study we found that in the latter river system members of the genus Eulimnogammarus were involved.

In this paper comparative descriptions will be given of all members of the E. simoni-group, along with a key for their identification. The distribution of the various species will be discussed and is plotted in maps. Where possible, notes will be given on the variability and the ecology of the different species.

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CHARACTERS OF THE ECHINOGAMMARUS SIMONI-GROUP

The species treated in this paper are closely related to Echinogammarus simoni (Chevreux, 1894). They have a combination of characters in common, which clearly distinguish them from other species groups within the genera Echinogammarus or Chaetogammarus :

1) the metasome never has teeth-like projections or spines (some setules may occur however on the posterior margin of the metasome segments);
2) the hands of the first and second gnathopods are almost equal in size (this is also the case in some Chaetogammarus species; in members of the E. pungens-group and of the E. berilloni-group, the hand of the second gnathopod is always much larger than that of the first);
3) the carpus of the second gnathopod is more or less elongated in this group (in both the E. pungens-group and of the E. berilloni - group, this segment is short);
4) the segments of the fifth to seventh legs are only sparingly setose;
5) the basal segments of these legs never bear setae on their inner surface;
6) the dorsal surface of the urosome lacks long setae;
7) the inferior margin of the coxal plates of the anterior four pairs of legs are set with small setules (in Chaetogammarus these margins never bear setae);
8) adapted to life in fresh waters.

This combination of characters makes the simoni-group more or less intermediate between the genera Echinogammarus and Chaetogammarus. This was a reason for Schellenberg, 1937 to create the new subgenus Homoeogammarus for the species G. simoni and G. tacapensis and later, in 1943, another new subgenus Parhomoeogammarus for Gammarus

lusitanus. Stock, 1968:18 already discussed this problem and considered both Homoeogammarus and Parhomoeogammarus junior synonyms of Echinogammarus. Notwithstanding certain resemblances to Chaetogammarus, we still believe - after weighing the various characters against each other - that it is best to retain simoni and its relatives as a species-group within the genus Echinogammarus. This opinion is chiefly based upon the consideration that no clear-cut differences can be indicated, and that intermediates between the various species-groups are found.

KEY TO THE SPECIES OF THE ECHINOGAMMARUS SIMONI-GROUP (BASED ON ADULT MALES ONLY)

1a) Flagellum of A 2 with calceoli ..... Echinogammarus lusitanus (Schellenberg, 1943)
b) Flagellum of A 2 without calceoli 2

2a) Eyes elongate reniform, more than twice as long as wide; medial palmar spines of P 1 and P 2 truncated ..... Echinogammarus obtusidens nov. spec.
b) Eyes ovate, less than twice as long as wide; medial palmar spines rounded or pointed 3

3a) Peduncle segments 4 and 5, and flagellum of A 2 armed with brushes of densely implanted, long setae ..... Echinogammarus simoni (Chevreux, 1894)
b) Peduncle segments and flagellum of A 2 armed with shorter setae 4

4a) Accessory flagellum of A 1 one-segmented. Peduncle segments 4 and 5, and flagellum, of A 2 with some transverse rows of setae, 1 to 1.5 times as long as the diameter of the segments ..... Echinogammarus tacapensis (Chevreux & Gauthier, 1924) *)
b) Accessory flagellum of A 2 three-to four-segmented. A 2 armed with very short setae only ..... Echinogammarus lochites (Margalef, 1956)

Echinogammarus simoni (Chevreux, 1894)

Gammarus simoni Chevreux, 1894:171; Chevreux, 1901:217; Chevreux, 1910:228; Ferrer Galdiano, 1921:377; Gauthier, 1932:107; Margalef, 1944:201; Margalef, 1953:199; Margalef, 1956:33.
Gammarus (Homoeogammarus) simoni; Schellenberg, 1937:272; Ruffo, 1939:58.

Material examined.-

Tunisia: Oued el Bey, near Gabès, 4 specimens (MNHN).
- Wells and trickles of Oued Gabès, 1923, 8 specimens (MNHN).

Algeria: River Bekkaria, near Tébessa, close to the Tunisian border, between Gafra and Constantine, 10 July 1970, clear, moderately fast-running, sand and gravel bottom, 0.5 m wide and 5 - 10 cm deep, dense vegetation, many specimens, many of them in precopulation (ZMA).
Ain-Sarba ouarsenis, alt. 1100 m, 3 specimens (MNHN).
Djelfa, province Alger, Oued Melâh, 6 specimens (MNHN).
Constantine, province Constantine, 6 specimens (MNHN).
Sources de Sidi Mérid, near Constantine, province Constantine, 11 specimens (MNHN).
Mont Edough, near Bône, province Bône, 3 specimens (MNHN).
Batna, province Batna, 4 specimens (MNHN).

Portugal:
prov. Leiria; Río Lena on road N 243 near Porto de Mós and Batalha, 25 June 1970, very polluted, moderately fast-running, about 3 m wide and 20 - 50 cm deep, stony bottom, temp. 17.8° C, pH 6.0 - 6.5, Cl 86 mg/l, Ca 83 mg/l, about 20 specimens (ZMA).
prov. Lisboa; Small brook on road N 116, near Gradil near Mafra, 26 June 1970, clear, slowly running, large stones and almost stagnant pools in between them, no vegetation, 20 m wide, 10 cm deep, pH 6.5, Cl 56 mg/l, Ca 121 mg/l, many specimens, many of them in precopulation; most animals were found outside the water, lying on moist sand (ZMA).
- Río Cheleiros, near village Pero Pinheiro, near Mafra, 26 June 1970, moderately polluted, about 10 m wide and 10 - 20 cm deep, stony bottom, vegetation of Chara spec., temp. 17.0° C, pH 6.0, Cl 44 mg/l, Ca 38 mg/l, about 20 specimens (ZMA).

*) Up to now this species is known from North Africa only.

Spain:

prov. Granada; Tributary of Río Cubillas near Deifontes, N. of Granada, 31 August 1970, clear, moderately fast-running, 2 - 3 m wide and 10 - 40 cm deep, bottom clay and gravel, temp. 16.3° C, pH 5.0 - 5.5, Cl 40 mg/l, Ca 78 mg/l, many specimens, many of them in precopulation (Z M A).

prov. Jaen; Río Gualdalbullón, on road N 323, E. of Arbuniel, 21 km S. of Jaen, 31 August 1970, slightly polluted, moderately fast-running, 1 - 2 m wide and 20 cm deep, pH 6.0 - 6.5, temp. 19.1° C, Cl 43 mg/l, Ca 152 mg/l, many specimens, many of them in precopulation (Z M A).

- Small brook, on road C 328, 1 km E. of Jimena, E. of Mancha Real, 31 August 1970, slightly polluted, fast-running stream, 30 - 50 cm wide and 10 - 20 cm deep, temp. 19.8° C, pH 6.0, Cl 21 mg/l, Ca 61.4 mg/l, many specimens, some of them in precopulation (Z M A).

prov. Ciudad Real; Tributary of Río Guadiana, 2 km E. of Piedrabuena, on road N 430, W. of Ciudad Real, 7 September 1970, slightly polluted, moderately fast-running, stony bottom, 2 m wide and 10 - 20 cm deep, dense vegetation of Scirpus spec., temp. 19.3° C, pH 6.0, Cl 27 mg/l, Ca 56 mg/l, many specimens, one of them in precopulation (Z M A).

- Small brook, N. of Alcolea de Calatrava, on road N 430, 7 km S.E. of Piedrabuena, 7 September 1970, clear, slowly running, muddy bottom, 1 m wide and 5 cm deep, vegetation of Scirpus spec., temp. 21.8° C, pH 7.0, Cl 26 mg/l, Ca 100 mg/l, many specimens (Z M A).

prov. Alicante; Cascada el Algar, N.E. of Callosa, on road C 3318 N.E. of Benidorm, 10 September 1970, under waterfall, clear, slowly running, slightly polluted, vegetation of mosses, temp. 15.0° C, pH 6.0 - 6.5, Cl 23 mg/l, Ca 60 mg/l, many specimens, one pair of them in precopulation (Z M A).

- Fuente de los Molinos, at Finestrat, 11 km E. of Benidorm, 10 September 1970, moderately flowing well, fed by 15 pipes, slightly polluted, temp. 18.8° C, pH 6.0, Cl 23 mg/l, Ca 60 mg/l, many specimens (Z M A).

- Cemented well, near Confrides on road C 3318, 38 km E. of Benidorm, 8 September 1970, very polluted almost stagnant water, in artifical basin of 40 x 40 x 10 cm, temp. 16.0°C, pH 5.5 - 6.0, Cl 25 mg/l, Ca 40 mg/l, 20 specimens (Z M A).

Description.-

Echinogammarus simoni is a rather small species; the largest male out of a sample of about 100 specimens had a length of 10 mm, but usually it is much smaller. The general appearance of the species is a rather compact one. The colour of live specimens is largely variable, from very pale opaque to grey and even brownish-red.

Male: The lateral lobes of the head (fig. 1 A) are rounded. The eyes are small, varying from almost rounded to twice as long as wide in very large males. They are well-separated from the mid-dorsal line.

The first antenna (fig. 1 B) is nearly half as long as the total body length. The peduncle is short, the second segment about half as long as the first, and twice as long as the third segment. The main flagellum consists of 26 to 35 segments, armed with short setae. The accessory flagellum is short, 6-segmented.

The second antenna (fig. 1 C) and its armature in particular, are most characteristic. The peduncle segments are robust. The gland cone of segment 2 is very short. Segment 5 is little longer than segment 4. The distal three-quarters of the fourth and the entire fifth peduncle segments are provided with transverse rows of long, densely implanted setae.

The 10 - to 12-segmented flagellum is covered with densely implanted setae like the last two peduncle segments. The length and the number of setae on each segment diminish towards the top of the flagellum. In general the length and the number of setae increase with age.

The mandible palp (fig. 1 D) has an unarmed first segment. The third segment has 5 or 6 long terminal setae and a comb of setae along the inferior margin, decreasing in length towards the distal end. There are two lateral groups of setae on each side.

The first and second gnathopods (figs. 2 A en 2 B) are almost equal in size, but different in shape: the hand of P 1 is pyriform, about twice as long as wide. There is always a well-developed pointed medial palmar spine, clearly separated from a row of three stronger and two smaller spines near the palmar angle. The hand of P 2 also is twice as long as wide, but the palm is almost transverse, having a strong medial palmar spine, separated from a row of 5 strong spines implanted

near the angle of the palm. The margins of the first and second coxal plates are provided with rather long setae.

Legs 3 to 7 are rather short. Legs 3 and 4 (figs. 1 E and 1 F) only have a few tufts of short setae. The corners of the 3rd and 4th coxal plates are rounded. The basal segment of the fifth leg (fig. 1 G) is short, less than 1.5 times as long as wide, and has a strong backward protruding lobe. The other segments are armed with some groups of spines, sometimes intermixed with some short setae. The basal segment of legs 6 and 7 (figs. 2 C and 2 D) does not have a backward protruding lobe. For the remainder these legs resemble leg 5.

The third uropod (fig. 1 H) has a very short, reduced inner ramus, with one or two spines near the top. The outer ramus is much longer, armed with a variable number of spines, placed in groups along the inner and outer margins. Intermixed with these spines, plumose setae, almost twice as long as the spines, can be found. The number of setae is variable and increases with age.

The telson lobes are elongate (fig. 1 I). They are usually armed with 1 to 3 spines near the top and some additional short setae. Sometimes there is a subbasal spine.

The segments of the metasome are ornamented in general with some setules near the articulation with the next segment. The urosome has no dorsal elevations or excavations. The number of spines is largely variable; in general a middorsal group and two lateral groups are represented. Each group of spines is accompanied by at least one seta.

The postero-inferior corner of all three epimeral plates is sharply produced. Near the ventral margin of the second and third plates some small spines can be found.

Female: Like in most other gammarids there is a marked sexual dimorphism in this species. The most characteristic is the absence of groups of long setae on the second antenna. Moreover, the hands of the gnathopods are much smaller and are devoid of the strong medial palmar spine.

Females are much smaller than males. In ovigerous specimens, the eggs are clearly visible because of their clear blue colour.

Variability.-

The variability pattern in this species is very similar to that encountered in other groups of gammarids such as the Gammarus locusta-group, the Echinogammarus pungens-group and the Gammarus pulex-group. As in these groups, the structure of the mandible palp, the setation of the 2nd antenna, the dorsal contour of the urosome, and the morphology of the legs are rather constant. Age dependent characters are the shape of the basal segments of legs 5 to 7 and the number of setae and spines implanted on the legs. In adult specimens the eyes are relatively more elongated than in juveniles. Likewise variable is the shape of the epimeral plates, the armature of the telson lobes, the dorsal armature of the urosome, and the number of plumose setae on the inner and outer margins of the exopod of the 3rd uropod. It might be important in this context that populations from Algeria have a much denser setation of their third uropods than the Iberian specimens. Study of more material will be necessary to evaluate the taxonomic significance of this feature.

Ecology.-

This is a species from small, or sometimes very small water bodies, such as wells, trickles, and upper reaches of rivers, always with a raised content of Ca^{++} ions. It has never been found together with other species. It seems that the species can stand a rather high degree of pollution and high temperatures.

Distribution.-

Echinogammarus simoni is known from Tunisia, Algeria, Morocco, and the southern parts of Spain and Portugal (see map I).

Chevreux, 1901:217, reported the species also from La Galite, an island in the Mediterranean sea off the Tunisian coast.

Remarks.-

Margalef, 1956 reported E. simoni from two localities in the drainage system of the Rio Duero and from a locality near Madrid. Last summer, while visiting these localities (and other localities in the valley of the Rio Duero), Eulimnogammarus toletanus Pinkster & Stock, 1970 was found only. This species, which differs clearly from E. simoni in the relative size of the gnathopods, has many features in common with E. simoni, the very setose second antennae being the most striking. Since Eulimnogammarus toletanus was not distinguished until 1970, it seems highly probable that Margalef has mistaken this species for E. simoni. Although the original material was not reexamined, Margalef (in litteris) holds the same opinion. Therefore, it was thought wise to give a list containing all localities of Eulimnogammarus-species known from Spain in Appendix I. These localities are plotted in map V.

Echinogammarus lochites (Margalef, 1956)

Gammarus lochites Margalef, 1956:31.

Material examined.-

Spain:

prov. Jaen; Fuente Umbría, in the Sierra de Cazorla, S.E. of Cazorla, May 1953, 3 paratypes, preserved in the University of Barcelona.

- Same locality, 31 August 1970, temp. 15.9° C, pH 6.5, Cl 1 mg/l, Ca 152 mg/l, 24 specimens (ZMA).
- Cemented waterbassin (2 x 5 x 1.5 m), fed by a well, at Burunchel near Cazorla, 31 August 1970, almost stagnant, rather clear, temp. 18.4° C, pH 6.0 - 6.5, Cl 18 mg/l, Ca 69 mg/l, many specimens (ZMA).
- Small tributary of Río Guadalimar, 1 km E. of Campo Redindo, on road C 3210, near Orcera, 7 September 1970, rather fast-running, clear, clay and gravel bottom, temp. 24.5° C, pH 6.0 - 6.5, Cl 21 mg/l, Ca 106 mg/l, many specimens (ZMA).

prov. Albacete; Río del Jardin, 5 km S.W. of San Pedro, on a cross-road of N 322, 39 km S.W. of Albacete, 8 September 1970, slightly polluted, fast-running, gravel bottom, open vegetation of Chara spec., temp. 17.7° C, pH 5.5, Cl 16 mg/l, Ca 81 mg/l, many specimens, many of them in precopulation (ZMA).

- Tributary of Río del Jardin, at Chospes, on road N 322, about 19 km N.W. of Alcaraz, 8 September 1970, slightly polluted, moderately fast-running, stony bottom, poor vegetation of Chara spec., temp. 15.6° C, pH 6.0, Cl 14 mg/l, Ca 170 mg/l, many specimens, one pair of them in precopulation (ZMA).
- Irrigation ditch along road N 322 at Chospes, about 19 km N.W. of Alcaraz, 8 September 1970, slowly running, moderately polluted, about 30 cm wide and 10 cm deep, temp. 16.1° C, pH 5.5, Cl 29 mg/l, Ca 230 mg/l, many specimens, many of them in precopulation (ZMA).

Description.-

In general appearance this species resembles E. simoni, except that the characteristic brushes of setae on the second antenna are absent. Like E. simoni it is a small species. The largest male out of a sample of about 100 specimens is 9 mm long. The colour of live specimens varies from opaque white to greyish, sometimes with red dots on the somites of metasome and urosome.

Male: The lateral lobes of the head (fig. 3 A) are truncate; the upper margin of the small rounded eyes is separated from the middorsal line by a rather large distance (fig. 3 A).

The first peduncle segment of A 1 is hardly longer than the second and about twice as long as

the third (fig. 3 B). The flagellum has 20 to 25 segments; the accessory flagellum is 3- to 4-segmented; both bear very short setae near the distal end of each segment.

The second antenna (fig. 3 C) is rather robust. The gland cone is short; the fourth and fifth segments, which are almost equal in length, are provided with few groups of short setae only. The flagellum is short, consisting of 9 to 11 segments only, bearing no other ornamentation than a few very short setae near the distal end of each segment. Calceoli are always absent.

The mandible palp has an unarmed first segment. The third segment has five terminal setae and a regular comb-like row of setae along the inferior margin. Two or three groups of setae are implanted on both sides of the third segment.

The first gnathopod has a pyriform hand, about 1.5 times as long as wide. There is always a strong medial palmar spine and a row of 4 or 5 spines near the palmar angle. The hand of the second gnathopod has about the same size as that of the first. As in E. simoni, there is a strong pointed medial palmar spine. The three spines near the palmar angle are less strong than in E. simoni. The first coxal plate is almost quadrangular, and the second is rounded. The coxal plates of legs 3 and 4 (figs. 3 I and J) have almost rectangular corners. The other features are as in E. simoni.

Legs 5 to 7 (figs. 2 E, F and G) show some smaller differences as compared with those of E. simoni; the spines are generally less strong and the posterior corners of the basal segments of P6 and P7 are a little more produced. The third uropod (fig. 2 H) is short, its endopod being much reduced. The exopod is armed with only 2 or 3 small groups of spines along the exterior margin, and with a few spines and setae along the interior margin. The telson lobes bear 2 or 3 distal spines, with some additional short setae. Occasionally a small spine is implanted near the outer margin.

The urosome segments are flat, without excavations or elevations. The number of spines and setae implanted on the urosome is largely variable. The epimeral plates are slightly produced backwards, usually less sharp but as scantily armed as in E. simoni.

Female: Since the males of this species lack outstanding characters, such as characteristic setation, etc., the females closely resemble the males. Of course there is sexual dimorphism in the hands of the gnathopods, which are smaller than those in males, and which do not have a medial palmar spine, but for the remainder no differences can be found.

Variability.-
In general, the variability encountered in this species resembles that found in E. simoni.

Ecology.-
Like E. simoni, this species seems to prefer waters with a very high amount of Ca^{++} ions. It can also stand a rather elevated degree of pollution and high temperatures.

Distribution.-
In spite of our dense sampling grid, we found this species in a rather small, isolated area in the Spanish provinces Jaen and Albacete only (see map II).

Echinogammarus obtusidens nov. spec.

Material examined.-

Spain:
prov. Cordoba; Small brook at Almodovar, near Cordoba, 24 September 1969, clear, moderately fast-running, dense vegetation, ♂ holotype and many paratypes have been deposited in the Zoölogisch Museum, Amsterdam (cat. no. Amph. 102.692).

- Small brook S. of Espeja, near Montilla, 1 September 1970, clear, moderately fast-running, clay bottom, dense vegetation, temp. 20.5° C, pH 6.5, Cl 1 mg/l, Ca 122 mg/l, many specimens.
- Río Carchena, about 5 km N.W. of Montilla, on road C 329, 1 September 1970, slightly polluted, moderately fast-running, clay bottom, temp. 26.0° C, pH 6.0, Cl 112 mg/l, Ca 117 mg/l, many specimens, many of them in precopulation (Z M A).

prov. Malaga; Well, W. of road C 337, 1 km N. of Valle de Abdalagis, near Antequera, 1 September 1970, clear, moderately fast-running, gravel bottom, temp. 17.2° C, pH 6.5, Cl 13 mg/l, Ca 156 mg/l, many specimens, many of them in precopulation (Z M A).

- Small brook, 500 m E. of Torremuele, near Torremolinos, on road N 340, 2 September 1970, clear, slowly running, gravel and clay bottom, dense vegetation, temp. 22.0° C, pH 6.5, Cl 35 mg/l, Ca 54 mg/l, many specimens (Z M A).

prov. Badajoz; Small brook, 16 km S.E. of Segura de Leon, S.W. of Fuente de Carlos, on road C 434, 3 September 1970, clear, slowly running, gravel bottom, 20 cm wide, 10 cm deep, temp. 25.9° C, pH 6.0 - 6.5, Cl 18 mg/l, Ca 60.4 mg/l, many specimens, one pair of them in precopulation (Z M A).

- Brook, fed by a well, 5 km S.E. of Segura de Leon, on road C 434, S.W. of Fuente de Carlos, 3 September 1970, clear, moderately fast-running, sand and gravel bottom, very dense vegetation, 1 m wide and 10 cm deep, temp. 18.6° C, pH 6.0, Cl 23 mg/l, Ca 55 mg/l, many specimens, many of them in precopulation (Z M A).

prov. Sevilla; Río Guadaira, W. of Moron de la Frontera, on road C 342, E. of Utrera, 3 September 1970, slightly polluted, moderately fast-running, stony bottom, without vegetation, temp. 23.0° C, pH 6.0 - 6.5, Cl 320 mg/l, Ca 220 mg/l, many specimens, many of them in precopulation (Z M A).

- Arroyo de Pilas, near Pilas, W. of Sevilla, 3 July 1970, clear, moderately fast-running, clay and gravel bottom, dense vegetation, about 50 cm wide and 5 - 15 cm deep, temp. 23.0° C, pH 6.5 - 7.0, Cl 238 mg/l, Ca 115 mg/l, many specimens, many of them in precopulation (Z M A).
- Brook near Bormujos, W. of Sevilla, 3 July 1970, slightly polluted, moderately fast-running, sand and clay bottom, without vegetation, 2 - 3 m wide and 5 - 30 cm deep, temp. 20.5° C, pH 7.0, Cl 131 mg/l, Ca 94 mg/l, many specimens (Z M A).

prov. Murcia; Brook, about 1 km W. of Aledo, near Totana, 29 August 1970, slightly polluted, moderately fast-running, about 30 cm wide and at most 10 cm deep, temp. 24.0° C, pH 6.0, Cl 110 mg/l, Ca 96 mg/l, many specimens (Z M A).

prov. Granada; Well, marked Obras Publicas, on road N 323 near Durcal, S. of Granada, 30 August 1970, slightly polluted, cemented water bassin, temp. 15.4° C, pH 5.5, Cl 13 mg/l, Ca 60 mg/l, many specimens, many of them in precopulation (Z M A)

prov. Jaen; Río Guadalbullon near junction of roads N 324 and N 323 near Jaen, slightly polluted, moderately fast-running, stony bottom, vegetation of *Chara* spec., about 4 m wide and 20 cm deep, temp. 19.5° C, pH 6.0, Cl 100 mg/l, Ca 245 mg/l, many specimens (Z M A).

- Tributary of Río Guadalquivir, on road C 328, 10 km N. of Jodar, S. of Ubeda, near junction of roads C 325 and C 328, 31 August 1970, clear, fast-running, about 40 cm wide and 10 cm deep, bottom of limestone with gravel, vegetation of *Chara* spec., temp. 21.0° C, pH 6.5, Cl 30 mg/l, Ca 150 mg/l, many specimens, one pair of them in precopulation (Z M A).
- Tributary of Río Toya on road C 328 near Hornos de Pea, 29 km W. of Cazorla, 31 August 1970, slightly polluted, moderately fast-running, stony bottom, without vegetation, about 75 cm wide and 10 cm deep, temp. 24.5° C, pH 6.5, Cl 45 mg/l, Ca 283 mg/l, many specimens, two pairs of them in precopulation (Z M A).
- Cemented well (10 x 1 x 0.4 m), W. of Marmolejo, near Andugar on road C 420, 1 September 1970, slightly polluted, slowly running, vegetation of *Chara* spec., temp. 19.8° C, pH 5.5, Cl 207 mg/l, Ca 283 mg/l, many specimens, some of them in precopulation (Z M A).

Description.-

A small species; the largest male found in our samples has a length of 8.5 mm. Except for some smaller details, the general habit of the species closely resembles that of *Echinogammarus lochites*. The colour of live specimens varies from almost white or greyish to brown, often with some reddish spots on the last metasome and urosome segments.

Male: The lobes of the head (fig. 4 A) are truncate. The eyes are reniform, more than twice as long as wide, separated from the middorsal line by a rather narrow gap. The retinal pigment is black.

The peduncle segments of the first antenna (fig. 4 B) are somewhat stronger than in E. *lochites*. The third segment is about half as long as each of the other two. The flagellum has 23 to 30 segments, all bearing short setae near their distal end. The accessory flagellum usually is 3-segmented.

The second antenna (fig. 4 C) has rather strong peduncle segments. Segment 4 is as long as segment 5. A dorsal spine is implanted near the base of the fourth segment. The fifth segment and the

14- to 18-segmented flagellum bear groups of setae, fewer in number and shorter than in E. simoni, but longer and more densely implanted than in E. lochites.

The mandible palp has an unarmed first segment. The terminal segment has only 4 terminal setae. A row of uniform setae is found along the inferior margin. Only one group of lateral setae is implanted on each side of this segment (see fig. 4 D).

As in all other members of this species-group the hands of the gnathopods are about equal in size. The first is somewhat pyriform with an oblique palm. In the middle of the palm a very characteristic, strong, truncated spine is implanted. A row of 3 pointed spines can be found near the palmar angle. The dactylus of this hand is short and does not attain the palmar angle (figs. 5 A and 4 E).

The palm of the second gnathopod (figs. 5 B and C) is more transverse than in P 1, but also provided with the same strong and truncated medial palmar spine. These spines resemble the obtuse and flask-shaped medial palmar spines found in representatives of the Gammarus locusta-group. The dactylus is longer than in P 1 and attains the palmar angle where a group of 4 to 5 pointed spines is found.

The third and fourth legs (figs. 5 D and E) are not very characteristic, armed with some spines and small groups of short setae.

The basal segment of the fifth leg (fig. 5 F) is short, hardly longer than wide. Its distal end is much wider than the proximal end of the ischium, forming a backward protruding lobe. The other segments are armed with groups of strong spines, sometimes with a few very short setae in between them. The basal segments of legs 6 and 7 are relatively longer than in leg 5, and do not form a protruding lobe. On the other segments, more groups of strong spines are found than in P 5.

The third uropod is better developed than in E. lochites. The exopod bears groups of spines on the inner and outer margin, mixed with setae, which are a little longer than these spines. These setae are never plumose (fig. 4 F). The telson lobes (fig. 4 G) are about twice as long as wide, armed with 1 to 3 distal spines and a few setae of the same length in between them.

The metasome segments are unarmed, except for some setules near the articulation with the next segment. The armature of the urosome segments consists of a variable number of spines and setae on each segment.

The postero-inferior corners of the 3 epimeral plates (fig. 4 I) are sharply pointed. Apart from short setules along the posterior borders, these plates are practically unarmed.

Female: Smaller than the male. Because of this lack of characteristic features, female specimens can be easily confused with females of other species within this group.

Ecology and distribution.-

The ecology of this new species closely resembles that known for E. simoni and for E. lochites. Until now it is known from 16 localities, all of them in the southern part of Spain, both from water systems draining into the Atlantic and into the Mediterranean (see map III).

Echinogammarus tacapensis (Chevreux & Gauthier, 1924)

Gammarus tacapensis Chevreux & Gauthier, 1924:53
Gammarus (Homoeogammarus) tacapensis; Schellenberg, 1937:272; Ruffo, 1939:58

Material examined.-

Tunisia: Collection Chevreux, Station 742, 14 May 1909, Berda near Guelma, province Bône, many specimens (MNHN).
- Sources et suintements des berges alluvionnaires de l'Oued Gabès (wells and trickles of Oued Gabès),

a few hundred meters upstream of Ras-el-Oued, on the right bank, 1923, 8 specimens (M N H N).
- Wells and trickles of Oued Gabès, fast-running, with rather dense vegetation, 6 July 1970, many specimens, many of them in precopulation (Z M A).

Description.-

A small species, maximum length observed 7 mm; most specimens, however, much smaller, not longer than 5 mm.

Male: The lateral lobes of the head are truncated (fig. 6 A). The eyes are small, almost circular, separated from the middorsal line by a rather large distance. The first antenna (fig. 6 B) is very characteristic, because of the accessory flagellum, which nearly always consists of 1 hardly discernible segment only. In very old males only, a very small second segment can be found (fig. 6 O). The peduncle segments 1 and 2 are equal in length and twice as long as the third. The flagellum is 25- to 29-segmented. The second antenna (fig. 6 C) has a short antennal gland. On the fourth and the fifth peduncle segments, which are of equal length, and on the segments of the flagellum some transverse rows of setae are implanted. These setae are 1 to 1.5 times as long as the diameter of these segments.

The first segment of the mandible palp (fig. 6 D) is unarmed. On the third segment a comb-like row of short plumose setae is implanted along the inferior margin. There are 4 terminal setae and a group of 2 or 3 setae on both the inner and outer surface of this segment.

The hands of the gnathopods are about equal in size (figs. 6 E en 6 F). The hand of the first leg (fig. 6 E) is about twice as long as wide and has an oblique palm. The strong, sharp medial palmar spine is clearly separated from a row of 3 other spines, diminishing in length, towards the palmar angle. The hand of the second leg (fig. 6 F) is relatively wider, about 1.5 times as long as wide, and has a less oblique palm. There is a medial palmar spine, which is well-separated from a row of 4 graduated angle spines.

The third and fourth legs (figs. 6 G and 6 H) are in a certain way characteristic, since their armature is even poorer than in the other members of this group. Only very few spines and short setae are present. The fifth leg (fig. 6 I) has a relatively short basal segment, 1.3 times as long as wide, with a backward protruding lobe, provided with a spine. The basal segments of the sixth and seventh legs (figs. 6 J and 6 K) are slightly more elongate and have less protruding lobes, likewise set with a small spine. The armature of these legs is poorly developed, consisting of some spines and very few, short setae only.

The third uropod (fig. 6 L) has a short inner branch and a well-developed, rather wide outer branch, armed with groups of spines and some short setae.

The telson lobes (fig. 6 M) are slightly longer than the basal segment of the third uropod. They are distally armed with some (up to 3) spines and a few setae, which are shorter than or as long as the spines.

The dorsal surface of the metasome is unarmed except for some setules near the articulation of the segments. The urosome segments have slight dorsal elevations. On the middorsal line a varying number of spines and setae is implanted. Lateral groups of elements have not been found (see fig. 6 N). The second and third epimeral plates have produced sharp postero-inferior corners. Some small spines and setae are implanted along the inferior and posterior margins.

Female: Like in other species of this group, the sexual dimorphism is visible in the gnathopods. The hand of the second leg is more developed than that of the first. Medial palmar spines are absent on both gnathopods.

Variability.-
Although few data are available, variability pattern seems to be identical to that of the other species of the group.

Ecology.-
Data on ecology are not available. Gauthier, however, found the species in artesian wells, which makes it likely that it inhabits waters with a high content of Ca^{++} ions.

Distribution.-
The species is known from some localities in Tunisia only.

Remarks.-
Ruffo, 1939: 55, described material from Gharian, S. of Tripolis, Libya, and attributes it to Gammarus (Homoeogammarus) tacapensis. Although we did not reexamine this material, we can hardly believe that it really belongs to this species. In Ruffo's specimens, the hand of gnathopod 2 is much stronger developed than that of gnathopod 1, while in the real E. tacapensis these hands are about equal in size. Moreover, the carpus of P 2 is very short in Ruffo's material versus more or less elongated in the material of Chevreux & Gauthier.

Echinogammarus lusitanus (Schellenberg, 1943)

Gammarus (Parhomoeogammarus) lusitanus Schellenberg, 1943: 2-4, fig. 1.
Gammarus lusitanus; Margalef, 1955: 166-168, fig. 14.
Non Echinogammarus lusitanus; Stock, 1968: 52-55, figs. 22 and 23.

Material examined.-

Portugal:
prov. Viana do Castello; Lugar de Mantelaãs, near Paredes de Coura, many specimens (syntypes), deposited in the Zool. Mus., Humboldt Univ., Berlin.
prov. Porto; Small brook about 2 km N. of Maia, near Chiolo, 22-VI-1970, a heavily polluted, moderately fast-running stream, with a stony bottom, about 1 m wide and 30 - 40 cm deep, pH 5.0, Cl 36 mg/l, Ca 7.2 mg/l, about 20 specimens (Z M A).
- Small brook, about 3 km S. of Maia, N. of Porto, on road N 14, 22 - VI - 1970, a slightly polluted, moderately fast-running stream with a dense vegetation, about 1 m wide and 30 cm deep, pH 5.0, Cl 28 mg/l, Ca 13 mg/l, many specimens (Z M A).
prov. Braga; Meandering, very small streams in a meadow, on the W. side of road N 14, 1 km S. of Vilanova, near Braga, 22 - VI - 1970, many streams of about 10 cm wide and 2 - 5 cm deep, clear, slowly running, gravel bottom, temp. 23.0° C, pH 4.5 - 5.0, Cl 9 mg/l, Ca 6.2 mg/l, many specimens, many of them in precopulation (Z M A).
- Brook about 5 km E. of Braga, on road N 103, 22 - VI - 1970, slightly polluted, moderately fast-running, gravel bottom, dense vegetation, 2 - 4 m wide and 10 - 40 cm deep, temp. 17.0° C, pH 5.0, Cl 11 mg/l, Ca 5.6 mg/l, about 20 specimens (Z M A).
- Brook 6 km W. of Barcelos on road N 103 near Braga, 22 - VI - 1970, very clear, fastly running, gravel bottom, dense vegetation, about 30 - 100 cm wide, 10 - 30 cm deep, temp. 17.3° C, pH 4.5, Cl 5 mg/l, Ca 4.1 mg/l, many specimens (Z M A).

Spain:
prov. Orense; Tributary of Río Miño, about 7 km E. of Orense, on road N 120, 8 - VII - 1969, clear, moderately running stream, about 1 m wide, Cl 11 mg/l, Ca 4 mg/l, many specimens (Z M A).
- Tributary of Río Miño, E. of Carballino, 32 km W. of Orense, 8 - VII - 1969, clear, moderately fast-running, gravel bottom, rather dense vegetation, about 30 cm wide, Cl 16 mg/l, Ca 0 mg/l, many specimens (Z M A).
- Tributary of Río Viñao on road N 541, between El Paraño and Brués, 41 km N.W. of Orense, alt. 700 m, 8 - VII - 1969, clear water, stony bottom, Cl 11 mg/l, Ca 4 mg/l, many specimens (Z M A).
prov. Lugo; Tributaries of Río Masma, along N 634 near Puerto de la Xesta, 7 - VII - 1969, alt. about 520 m,

fast-running, clear, granite bottom, Cl 14 mg/l, Ca 8 mg/l, many specimens, many of them in precopulation (Z M A).

prov. La Coruña; Small brook W. of Calo, about 7 km S. of Santiago, 8 - VII - 1969, slowly running, polluted, dense vegetation, about 1.5 m wide, 10 specimens (Z M A).

- Río Sionilla, near bridge in N 550, 8 km N.E. of Santiago, 8 - VII - 1969, clear, about 4 m wide, gravel bottom, Cl 10 mg/l, Ca 4 mg//, many specimens (Z M A).
- Río Mero near bridge at Cambre, 7 - VII - 1969, more than 10 m wide, rather dense vegetation, Cl 18 mg/l, Ca 8 mg/l, many specimens (Z M A).
- Small brook, about 3 km S. of Sigras, S.E. of La Coruña, 7 - VII - 1969, fast-running, gravel bottom, Cl 30 mg/l, Ca 10 mg /l, many specimens (Z M A).
- Tributary of Río Valinas near Celos, S.E. of La Coruña, 7 - VII - 1969, clear, moderately fast-running, about 1 m wide, gravel bottom, rather dense vegetation, Cl 15 mg/l, Ca 8 mg/l, many specimens (Z M A).
- Río Arteijo, about 3 km upstream of Arteijo, 7 - VII - 1969, very small stream with a gravel bottom, Cl 21 mg/l, Ca 4 mg/l, many specimens, many of them in precopulation (Z M A).
- Río Breja, S. of village Tabeayo, about 15 km S.S.E. of La Coruña, 7 - VII - 1969, clear, gravel bottom, Cl mg/l, Ca 6 mg/l, many specimens, many of them in precopulation (Z M A).
- Río Llenguelle, about 3 km S. of Ordenes, near bridge in N 550, 8 - VII - 1969, clear, stony bottom, about 2.5 m wide, Cl 11 mg/l, Ca 0 mg/l, many specimens, many of them in precopulation (Z M A).
- Small brook, near Ermita de Sta.Cruz, S. of Ordenes, 8 - VII - 1969, clear, fast-running, dense vegetation, about 75 cm wide, Cl 12 mg/l, Ca 10 mg/l, many specimens (Z M A).

prov. Pontevedra; Río Tenorio, on road N 541, N.N.W. of Pontevedra, 8 - VII - 1969, clear, fast-running, about 1.5 m wide, Cl 18 mg/l, Ca 0 mg/l, 10 specimens (Z M A).

- Tributary of Río Lerez, near Sotélo, on road N 541, 8 - VII - 1969, alt. 800 m, fast-running, clear, gravel bottom, remnants of Calluna-vegetation, Cl 6 mg/l, Ca 6 mg/l, many specimens, many of them in precopulation (Z M A).

Description.-

A small species; the largest male observed amongst some thousand specimens, was about 10 mm long. In general appearance the species can be easily distinguished from the other species in this group by the presence of calceoli on the second antenna of the male.

The colour of live specimens is normally a dark greyish brown, but sometimes a little paler with orange dots on metasome and urosome segments.

Male: The lateral lobes of the head are truncated (fig. 7 A). The eyes are reniform, more than twice as long as wide. The retinal pigment is black. Both the first and second antenna are short. The first two peduncle segments of A 2 (fig. 7 B) are equal in length and each about twice as long as the third segment. The 24- to 28-segmented flagellum and the 4- to 5-segmented accessory flagellum are sparsely setose.

The second antenna (fig. 7 C) has a well developed gland cone. The fourth and fifth peduncle segments are about equal in length, bearing only a few groups of setae. The proximal 5 to 7 segments of the 12- to 16-segmented flagellum are always provided with calceoli.

The mandible palp (fig. 7 H) has an unarmed first segment and a third segment with 5 long terminal setae. Only one group of setae has been found on both the inner and outer side of the third segment.

The first gnathopod is characterized by its hand, which is slender, about twice as long as wide, and provided with an oblique palm. A strong spine with a somewhat rounded top is implanted near the middle of the palm. The palmar angle is not provided with a row of strong spines as in the other members of this group, but with one strong spine only. Two or three smaller spines can be found on the inner surface of the hand. There never are smaller spines ('Stiftstacheln') along the posterior margin of the hand.

The hand of the second gnathopod (fig. 7 G) is a little shorter, more swollen than in P 1, and is almost oval. The palm is practically transverse, concave, and has a strong medial palmar spine with a rounded top. Five strong spines are implanted near the palmar angle, 3 in a row and 2 on the inner surface of the hand. There are no smaller spines ('Stiftstacheln') along the posterior

margin of the hand.

Many groups of long setae are implanted both on the inner surface and the posterior margin of the hand. The coxal plates of the first two legs (figs. 7 D and 7 E) have rounded inferior corners. The third and fourth legs differ from those of the other species within this group in having more groups of longer setae along the posterior margin of nearly all segments. The fifth leg (fig. 8 C) has a rather short basal segment, always less than 1.5 times as long as wide. Its distal end is much wider than the proximal end of the next segment, forming a protruding lobe. The next segments are armed with some spines and setae, the latter being normally 2 to 3 times as long as the spines.

The basal segment of legs 6 and 7 (figs. 8 D and 8 E) is narrower, hardly forming a protruding lobe. As in P 5, the setae occurring between spines are 2 to 3 times as long as these spines.

The endopod of the third uropod (fig. 8 F) is relatively longer than in the other members of this group. It can attain nearly 1/3 of the length of the first exopod segment. The second exopod segment is relatively long. The armature of both endo- and exopod is formed by groups of spines or setae or a combination of both. The setae are 2 to 3 times as long as the spines. On the inner margin of the exopod some setae are plumose. The telson lobes (fig. 8 G) are less than 1.5 times as long as wide. They are usually armed with 1 to 3 distal spines, in combination with 4 to 7 setae, the latter nearly twice as long as the spines. Very often 1 or 2 subbasal spines and setae can be found along the outer and inner margins.

The metasome segments (fig. 7 J) are unarmed, except for some small setules near the posterior margin of each segment. Urosome segments without dorsal elevations or excavations; they are armed with a variable number of small spines and setae, usually placed in one dorsal and two lateral groups. The second and third epimeral plates have sharp, produced ventro-posterior corners (fig. 7 I). Few short setae and some spines can be found along the inferior and posterior margin.

Female: Smaller than the male. The maximum length observed in our samples was 7 mm. In general, the eyes are somewhat smaller, more rounded than in the males.

The gnathopods (figs. 8 H and 8 I) have smaller hands and do not have a medial palmar spine. Near the palmar angle of the first hand a group of 5 spines is found, instead of the single spine in the male (see figs. 7 F and 8 H). The setation of the hands is denser than in the male. The flagellum of the second antenna lacks calceoli.

Ecology.-

Echinogammarus lusitanus always lives in waters with very low anorganic ion content, especially of Ca; the pH of these waters is low, always less than 5.0. On the other hand the species is able to live in rather polluted waters.

Distribution.-

The species is only known from the provinces Orense, Lugo, La Coruña and Pontevedra in Spain, and the adjacent parts of Portugal (see map IV).

Remarks.-

In literature there is confusion, both about the morphology and the systematical position of this species. Schellenberg, 1943: 2, gave a rather good description of the species, but failed to provide figures of all characteristic features. In the text, he mentioned the presence of calceoli on the flagellum of the second antenna, but in the illustration of this antenna, there were none. He certainly noticed morphological similarity to both *E. simoni* and *E. tacapensis*, but nevertheless he cre-

ated a new subgenus for his species, because of the different shape of the eyes and the absence of the so-called 'Stiftstacheln' on the hand of the first gnathopod of the male.

Margalef, 1953: 192, in a key for the determination of Iberian amphipods, places E. lusitanus in the group of animals without calceoli on their antennae.

Stock, 1968: 53, gave a description of what he considered to be E. lusitanus, and discussed its systematical position. He pointed out that the species must be placed in the genus Echinogammarus (an opinion we still adhere to), but also that E. lusitanus was actually a member of the berilloni-group. He certainly was right, that the material he studied and figured belonged to the berilloni-group, but in fact this material was not identical with E. lusitanus, as became clear through a later study of the original type-material and of specimens collected during the 1969 and 1970 campaigns.

Although the problems about the identity of Echinogammarus lusitanus are solved now, it is still clear, that the species holds a special place even in the E. simoni-group. It must be included in this group, because of the combination of characters mentioned before, but it differs clearly from the other species in this group by the absence of 'Stiftstacheln' on the hand of the first gnathopod and by the presence of calceoli on the flagellum of the second antenna. Its ecological niche (waters with a low pH and poor in Ca^{++} ions) is completely different from that of the other members in this group and its isolated geographic distribution is in agreement with this special position.

APPENDIX I

Localities of Eulimnogammarus macrocarpus Stock, 1969 in the Iberian peninsula

Spain:

prov. Zaragoza; Río Piedra, near its confluence with Río Jalon, east of Alhama de Aragon, 3 specimens (type-locality) (ZMA).

prov. Madrid; Arroyo de la Cavina, S.W. of Aranjuez, 10 July 1969, fast-running, gravel, Cl 57 mg/l, Ca 540 mg/l, many specimens (ZMA).

prov. Toledo; Confluent of Río Tajo, between La Puebla de Montalban and Toledo, 10 July 1969, very shallow, muddy, marsh plants, about 60 cm wide, Cl 30 mg/l, Ca 70 mg/l, many specimens (ZMA).

prov. Teruel; Río Mezquin, 8 km S. of Alcaniz, near village Castelseras, 12 July 1969, about 40 cm wide, 30-40 cm deep, with Rorippa spec., filamentous algae and grass, Cl 50 mg/l, Ca 100 mg/l, many specimens (ZMA).

- Spring of the Río Mora, 3.5-4 km E. of Mora de Rubielos, 11 July 1969, muddy, about 30 cm wide, with Chara and pondweed, Cl 17 mg/l, Ca 78 mg/l, many specimens (ZMA).

Localities of Eulimnogammarus toletanus Pinkster & Stock, 1970 in the Iberian peninsula

Spain:

prov. Toledo; Arroyo Eschorchon, near bridge in road N IV, 11 km S. of Ocaña, 10 July 1969, narrow, muddy, marsh-plants, Cl 225 mg/l, Ca 528 mg/l, many specimens (type-locality) (ZMA).

- Arroyo de la Fuente de Séseña, near Antigua, S. of Madrid, 27 July 1970, moderately fast-running, slightly polluted, clay bottom, about 50 cm wide and 20 cm deep, temp. 17.0°C, pH 6.5, Cl 54 mg/l, Ca 352 mg/l, many specimens (ZMA).

prov. Madrid; Río Guadarrama on road C 404 near Batres and Navalcarnero, S. of Madrid, 27 July 1970, slightly polluted, moderately fast-running, sandy bottom, about 20 m wide and 30-40 cm deep, temp. 22.0°C, pH 6.0-6.5 (ZMA).

prov. Soria; Río de Madre Réjas, near cross-road to Réjas on road N 122, near San Esteban de Gormaz, 20 June 1970, clear, moderately fast-running, 20-80 cm wide, 10 cm deep, temp. 12.0°C, pH 5.5, Cl 9 mg/l, Ca 61 mg/l (ZMA).

- Confluent of Río Duero, on road N 122, 33 km W. of San Esteban de Gormaz, near El Burgo de Osma, 20 June 1970, clear, moderately fast-running, gravel bottom, 1-3 m wide and 10 cm deep, temp. 13.4°C, pH 6.5, Cl 0 mg/l, Ca 93 mg/l, 15 specimens (ZMA).

- Confluent of Río Duero, on road N 122, near Langa de Duero, W. of San Esteban de Gormaz, 20 June 1970, clear, rather fast-running, vegetation of Chara spec., 2-3 m wide, 10-50 cm deep, temp. 13.2°C, pH 6.5, Cl 2 mg/l, Ca 77 mg/l, many specimens (ZMA).

- Río Duero, along road N 122 near Langa de Duero, W. of San Esteban de Gormaz, 20 June 1970, clear, fast-running stream, about 10 m wide and very deep, vegetation of Phragmites, temp. 18.2°C, pH 5.5, Cl 8 mg/l, Ca 66 mg/l, 4 specimens (ZMA).

prov. Valladolid; Confluent of Río Duero, on road N 122, near Quintanilla, W. of Peñafiel, 20 June 1970, about 10 cm wide and 3 - 5 cm deep, clear, moderately fast-running, clay and gravel bottom, temp. 14.0°C, pH 6.5 - 7.0, Cl 9 mg/l, Ca 66 mg/l, many specimens (ZMA).

- Confluent of Río Duero, near Sardón de Duero, E. of Valladolid, 20 June 1970, clear, fast-running, sandy bottom, about 50 - 150 cm wide, 10 - 50 cm deep, temp. 12.5°C, pH 6.0, Cl 237 mg/l, Ca 158 mg/l, many specimens (ZMA).

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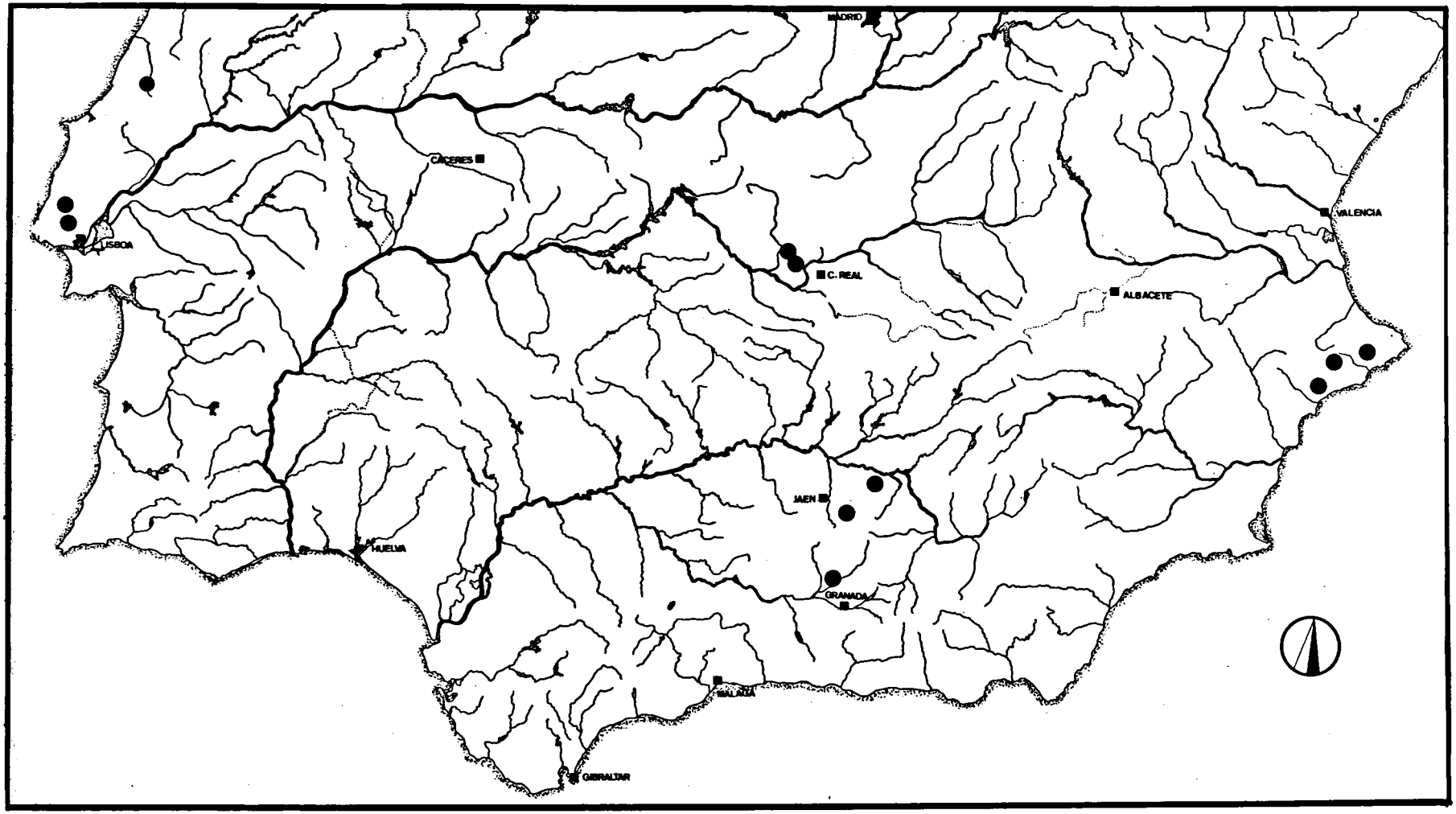
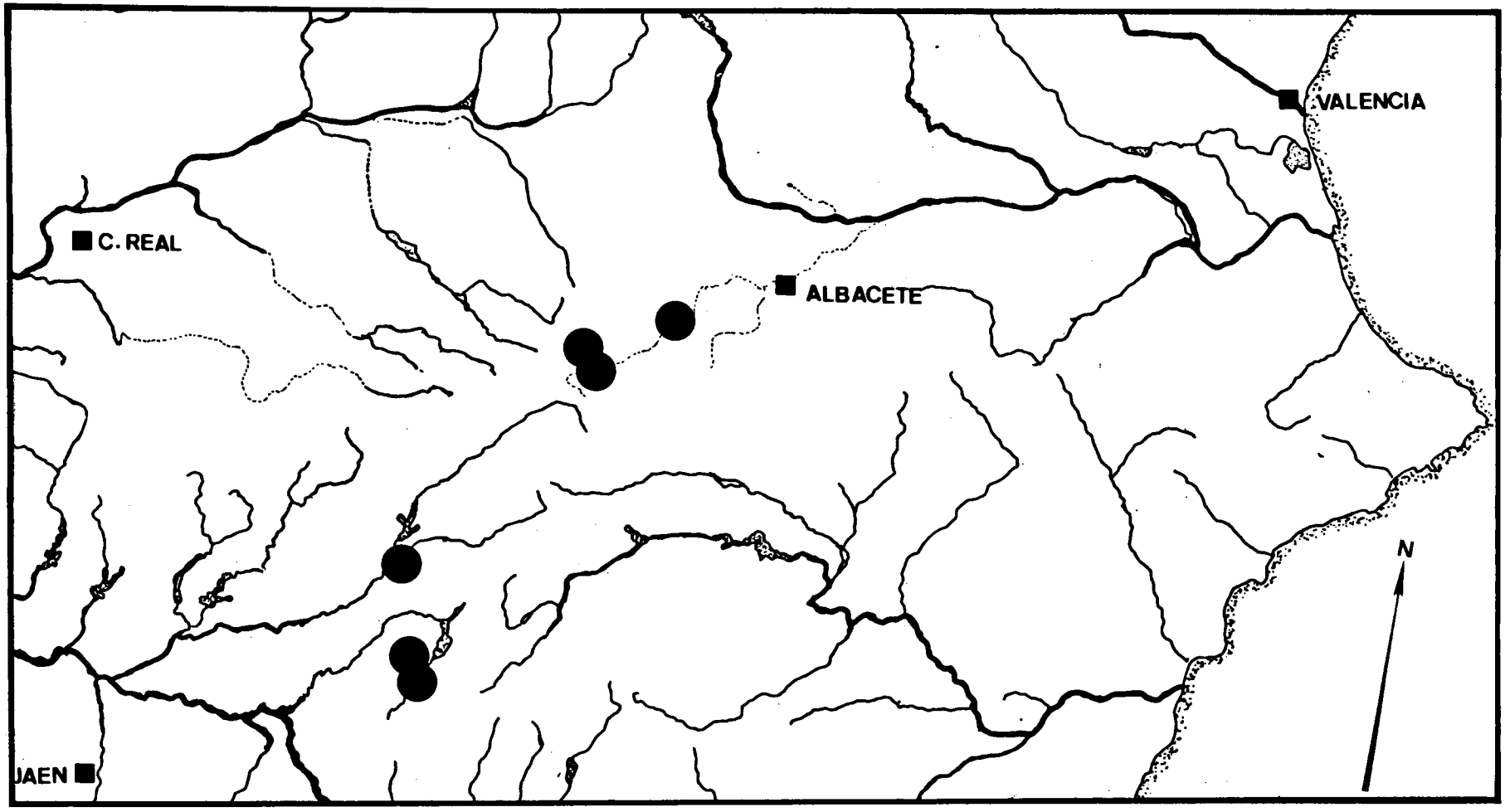
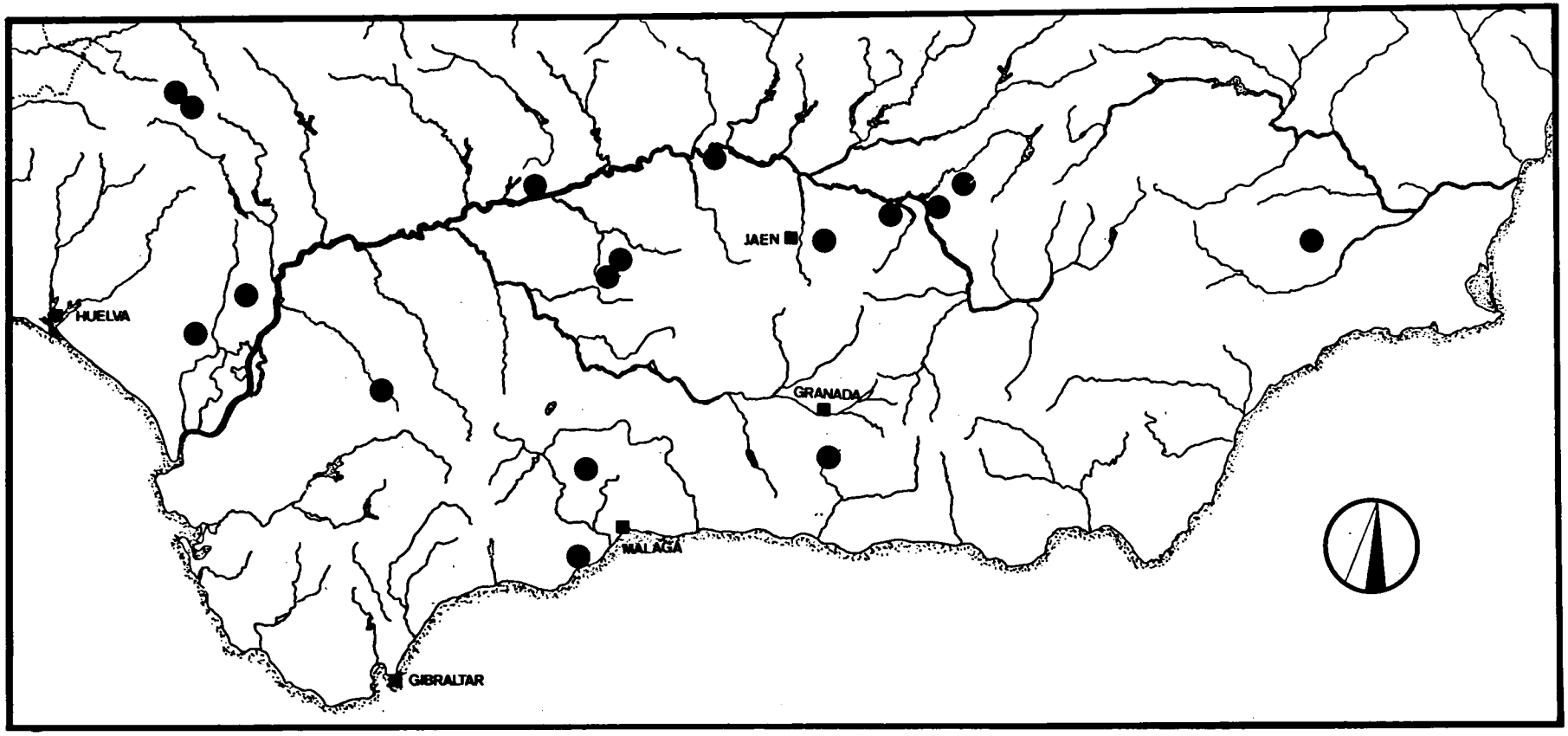
Map I Sampling grid 1969 and 1970 in the Iberian peninsula.
● positive sample
o negative sample



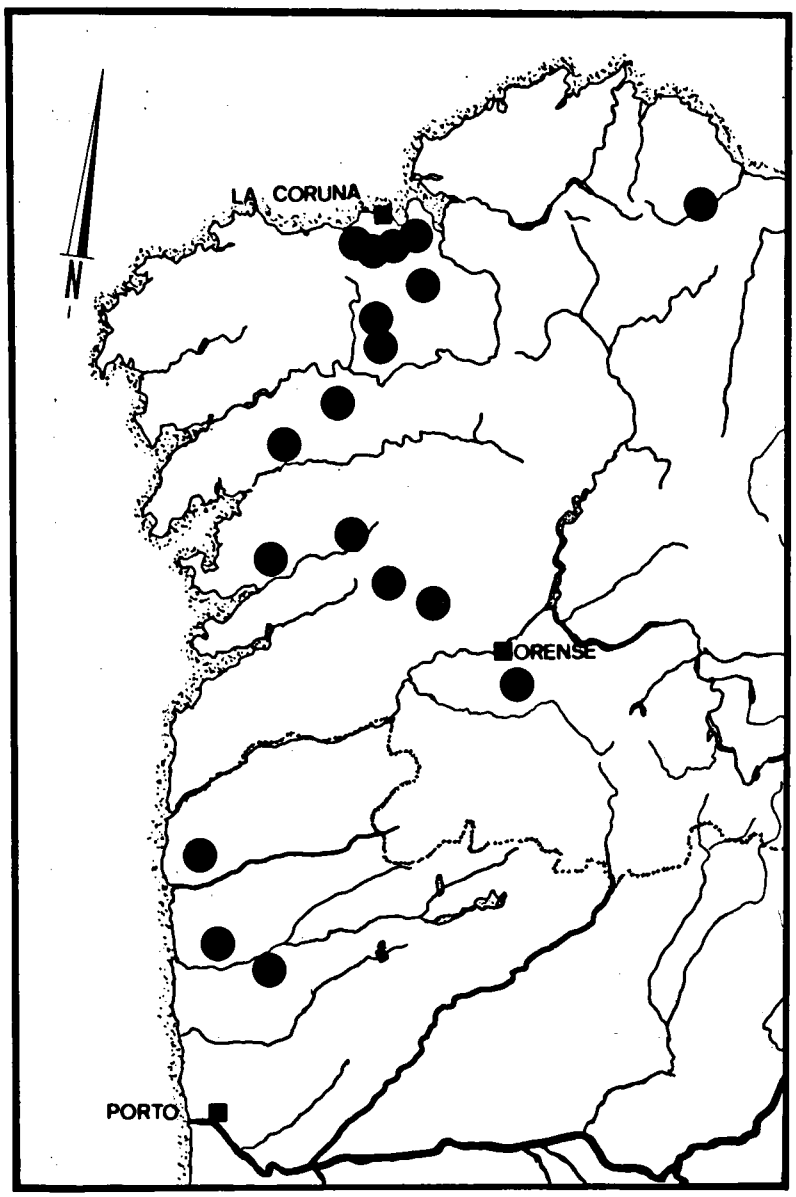
Map II Distibution of Echinogammarus simoni (Chevreux) in the Iberian peninsula.



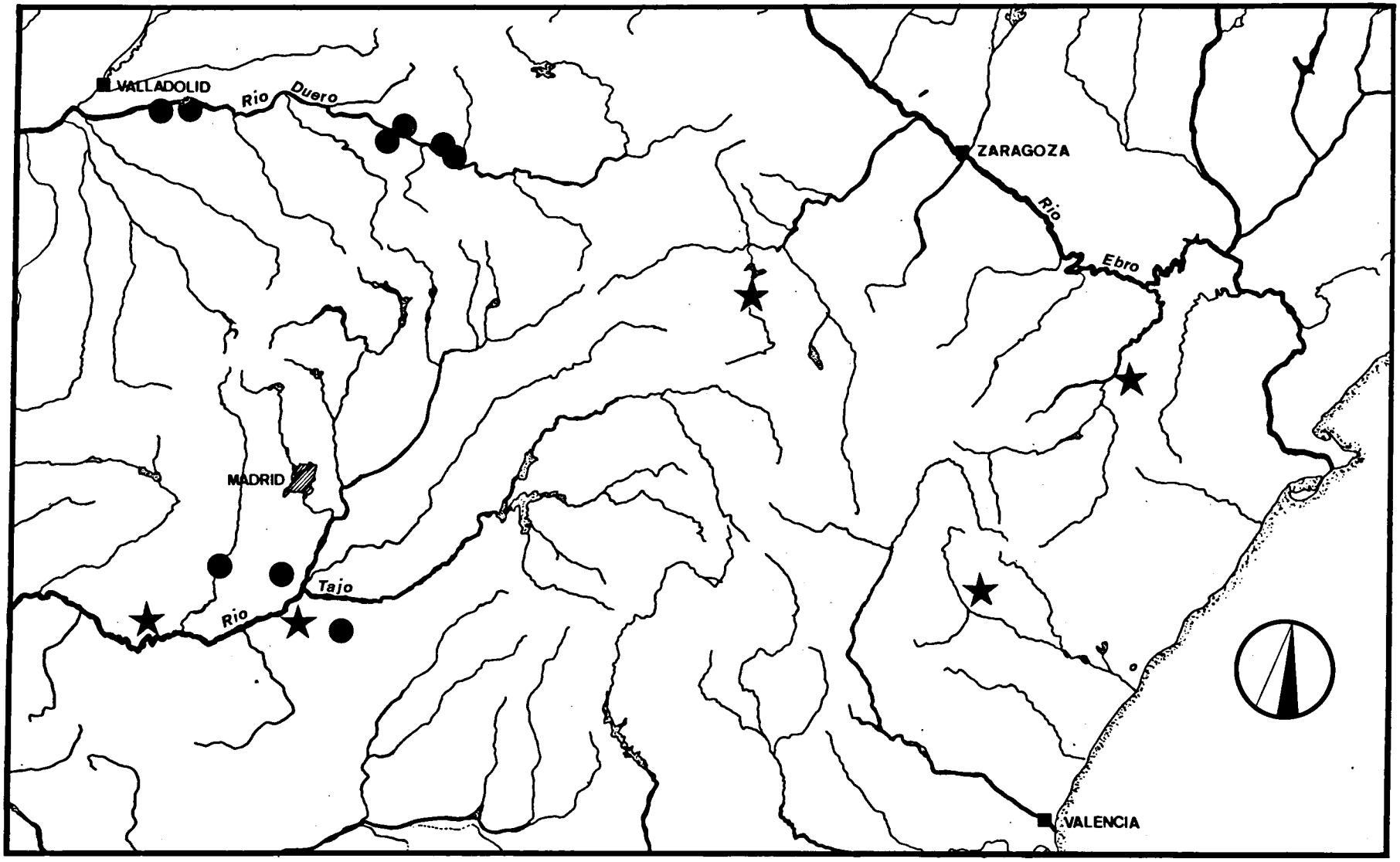
Map III Distribution of Echinogammarus lochitus (Margalef) in the Iberian peninsula.



Map IV Distribution of Echinogammarus obtusidens nov. spec. in the Iberian peninsula.



Map V Distribution of Echinogammarus lusitanus (Schellenberg) in the Iberian peninsula.



Map VI Distribution of Eulimnogammarus macrocarpus Stock (asterisks) and Eulimnogammarus toletensis Pinkster & Stock (dots) in the Iberian peninsula.

For explanation of the figures see page 115

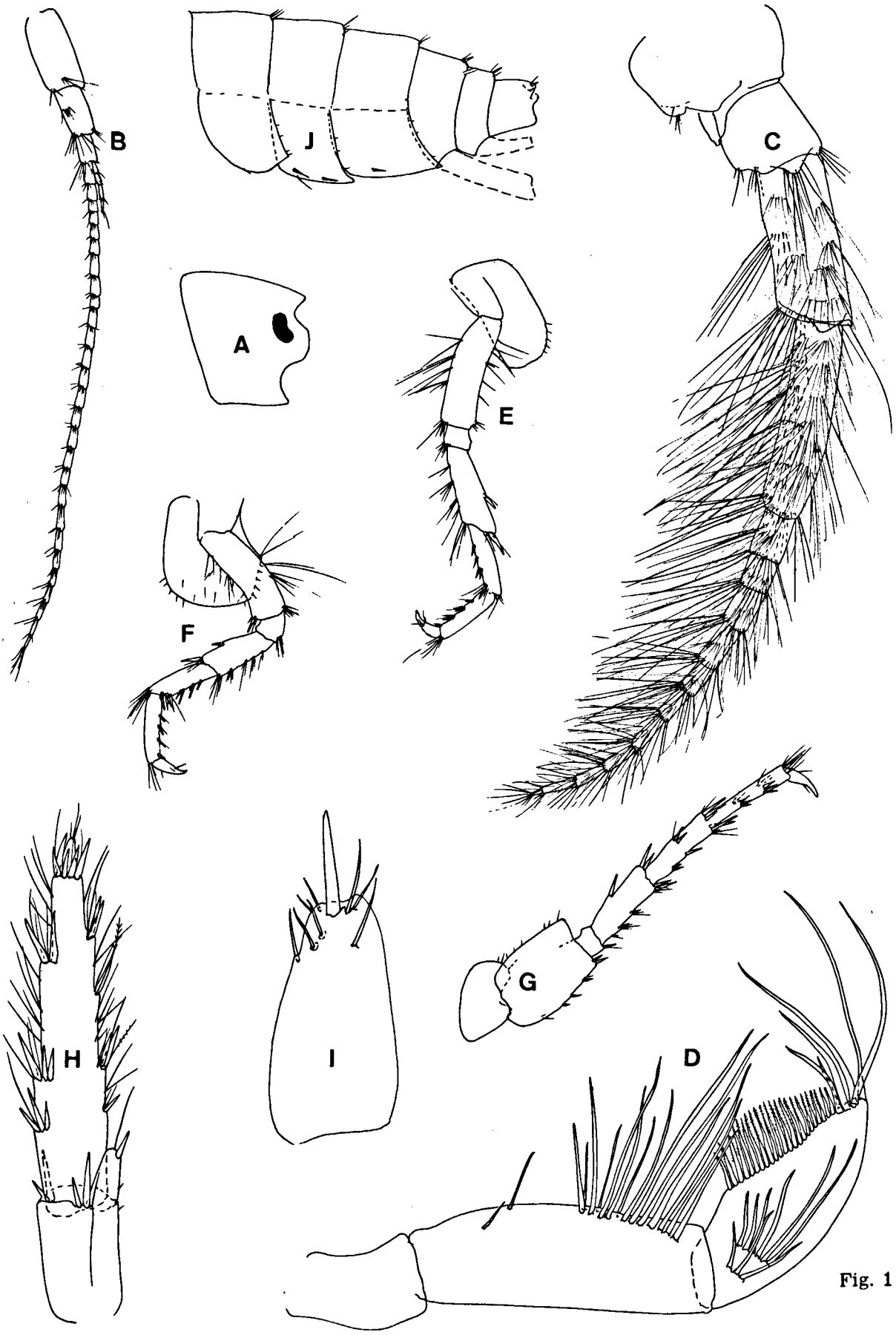


Fig. 1

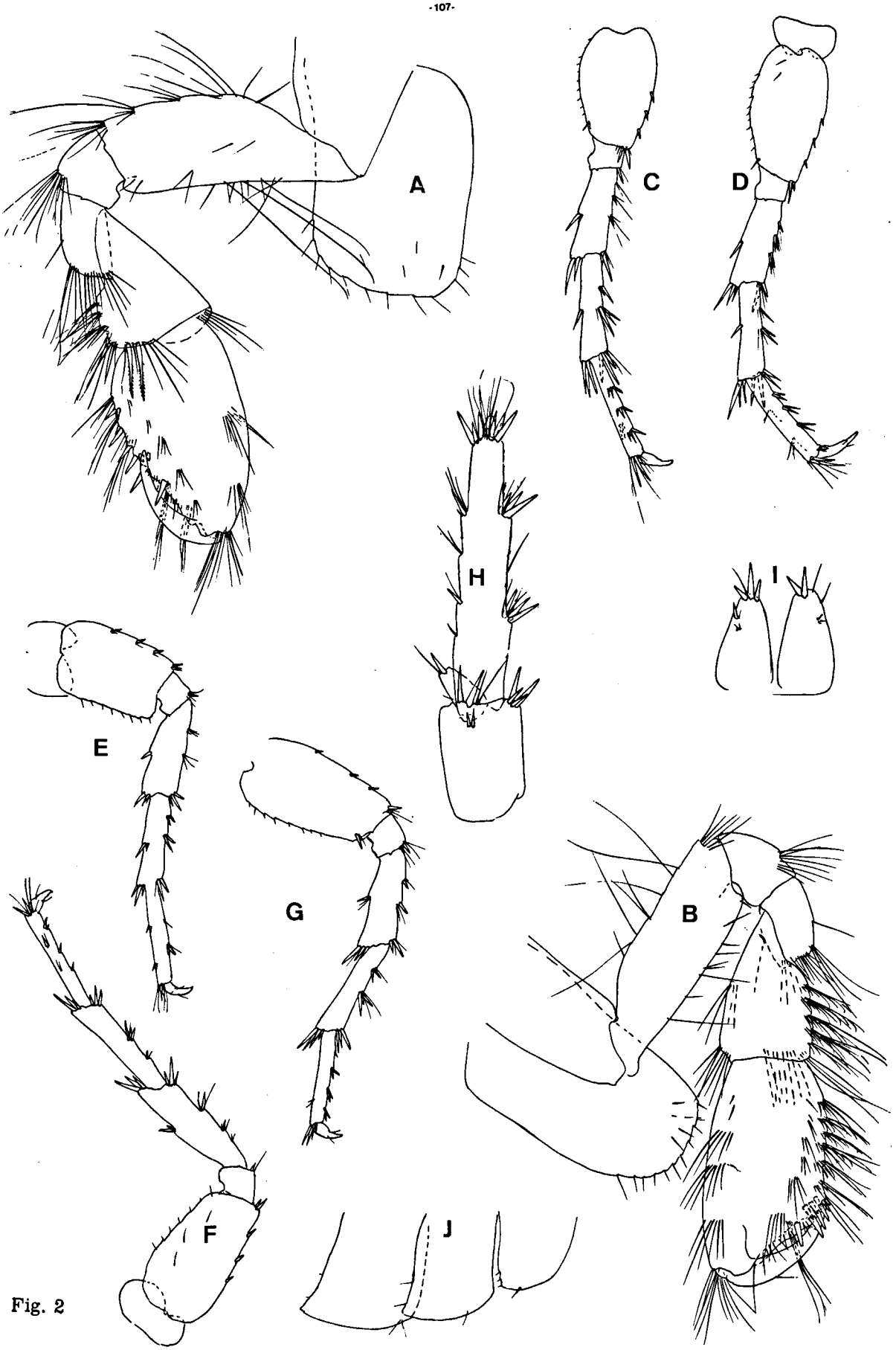


Fig. 2

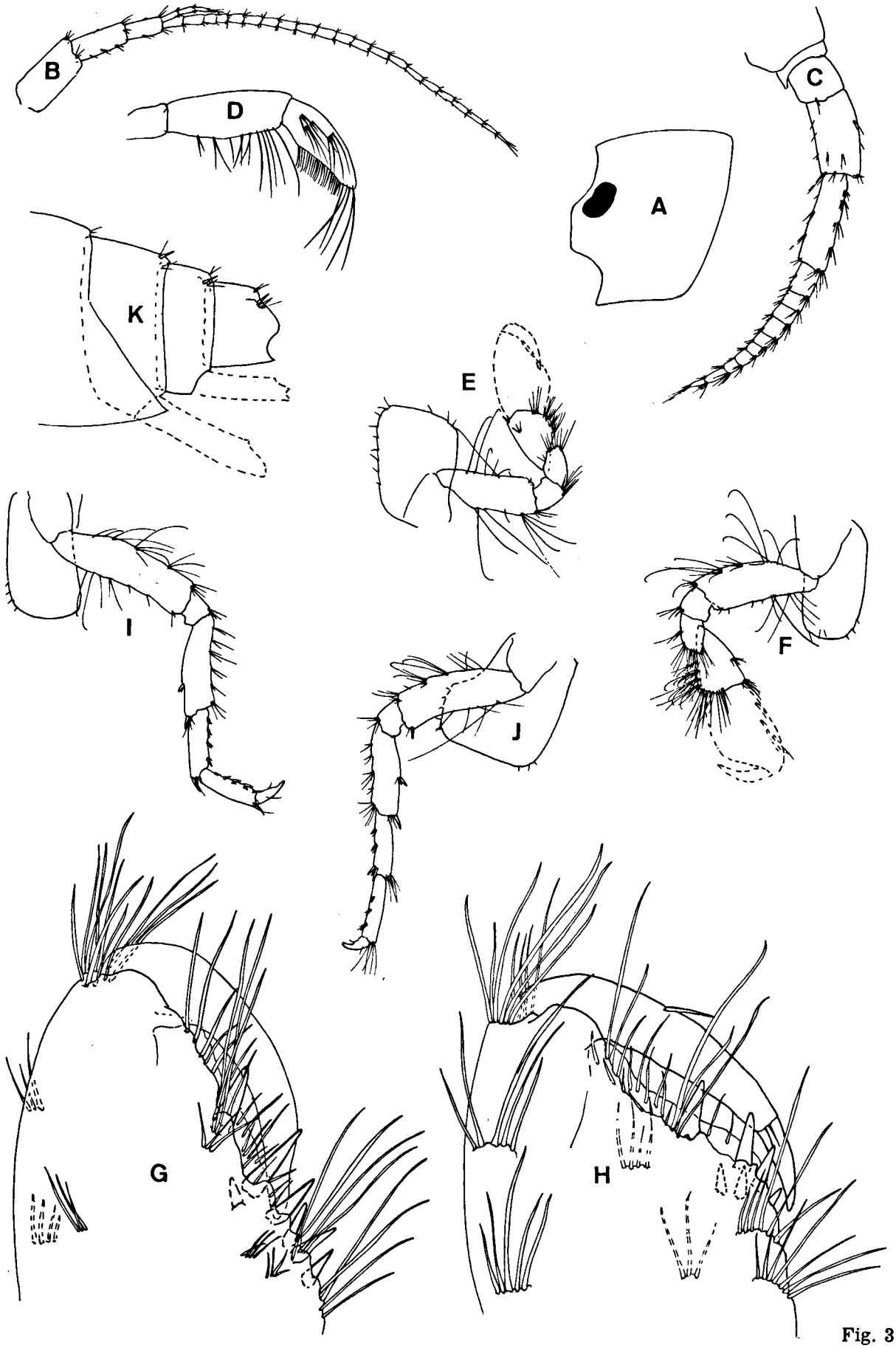


Fig. 3

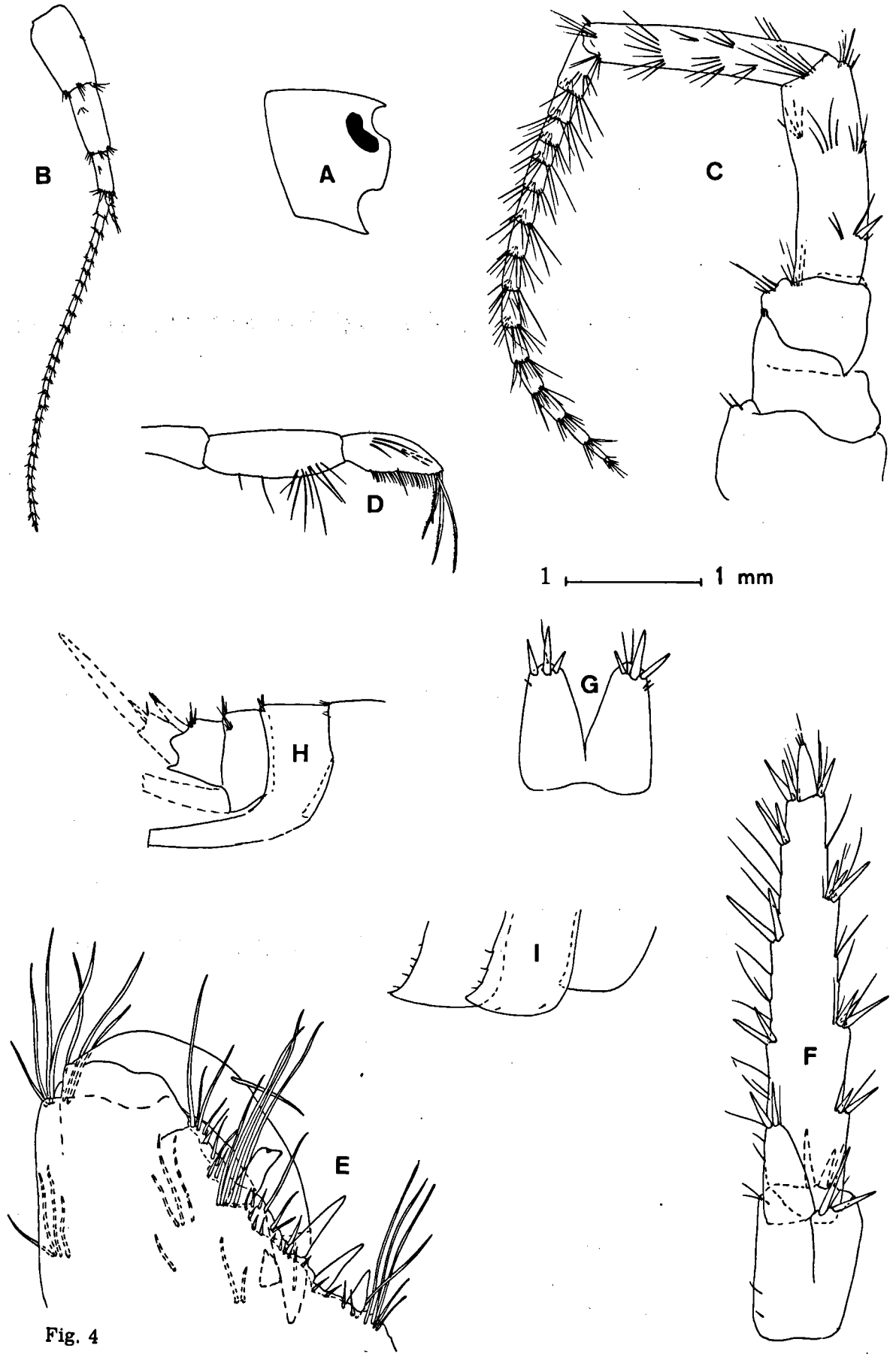


Fig. 4

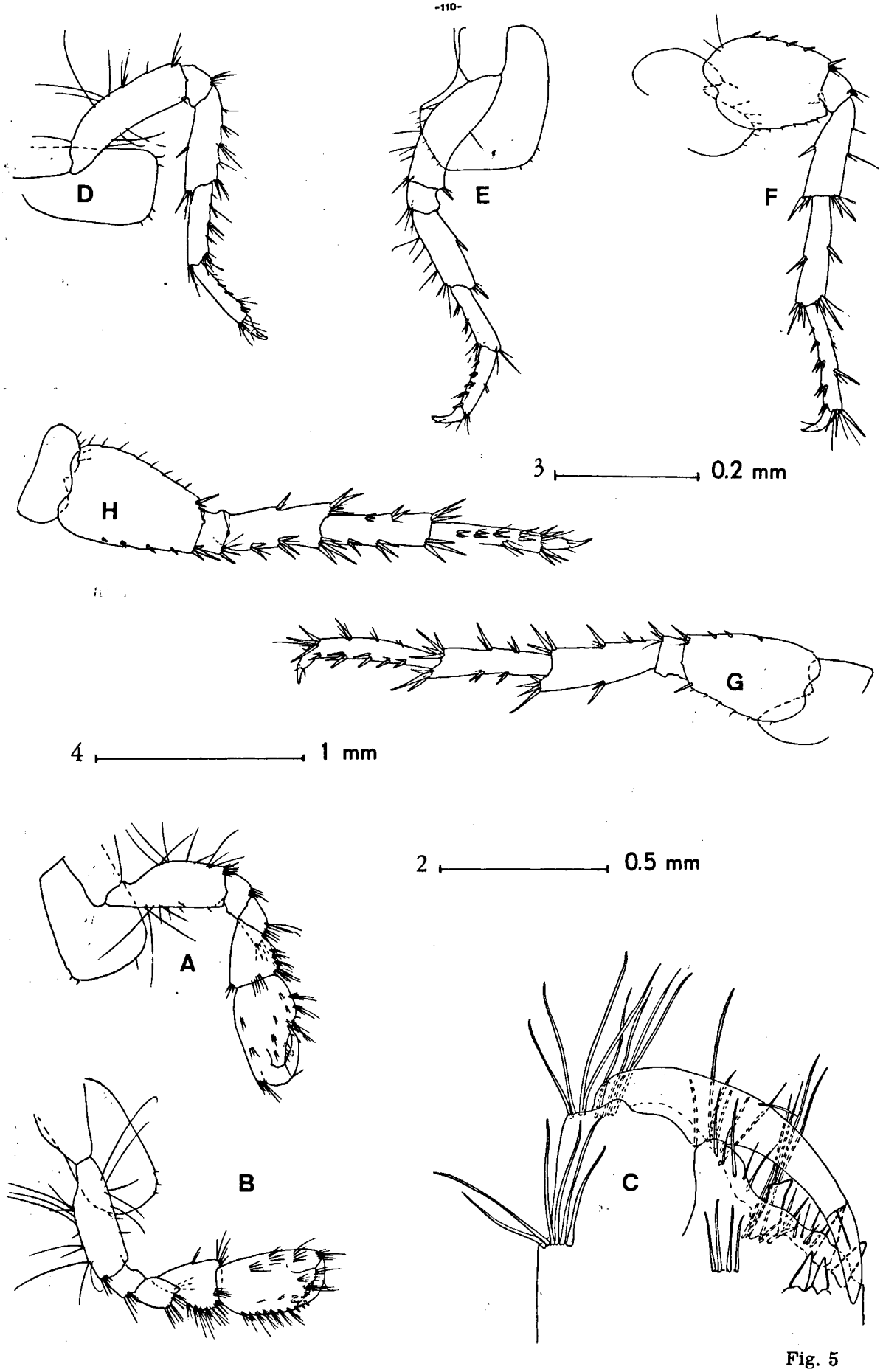


Fig. 5

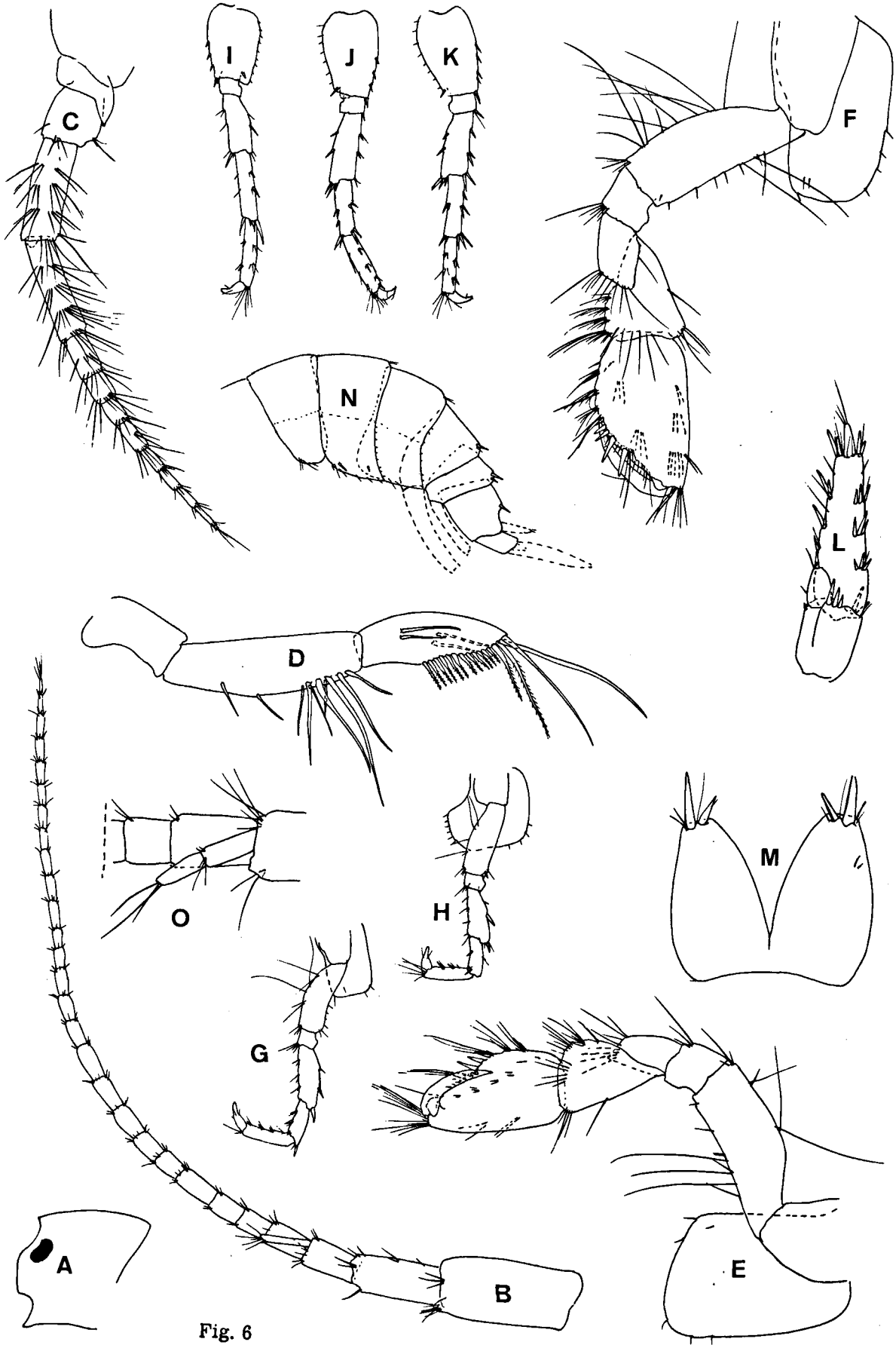


Fig. 6

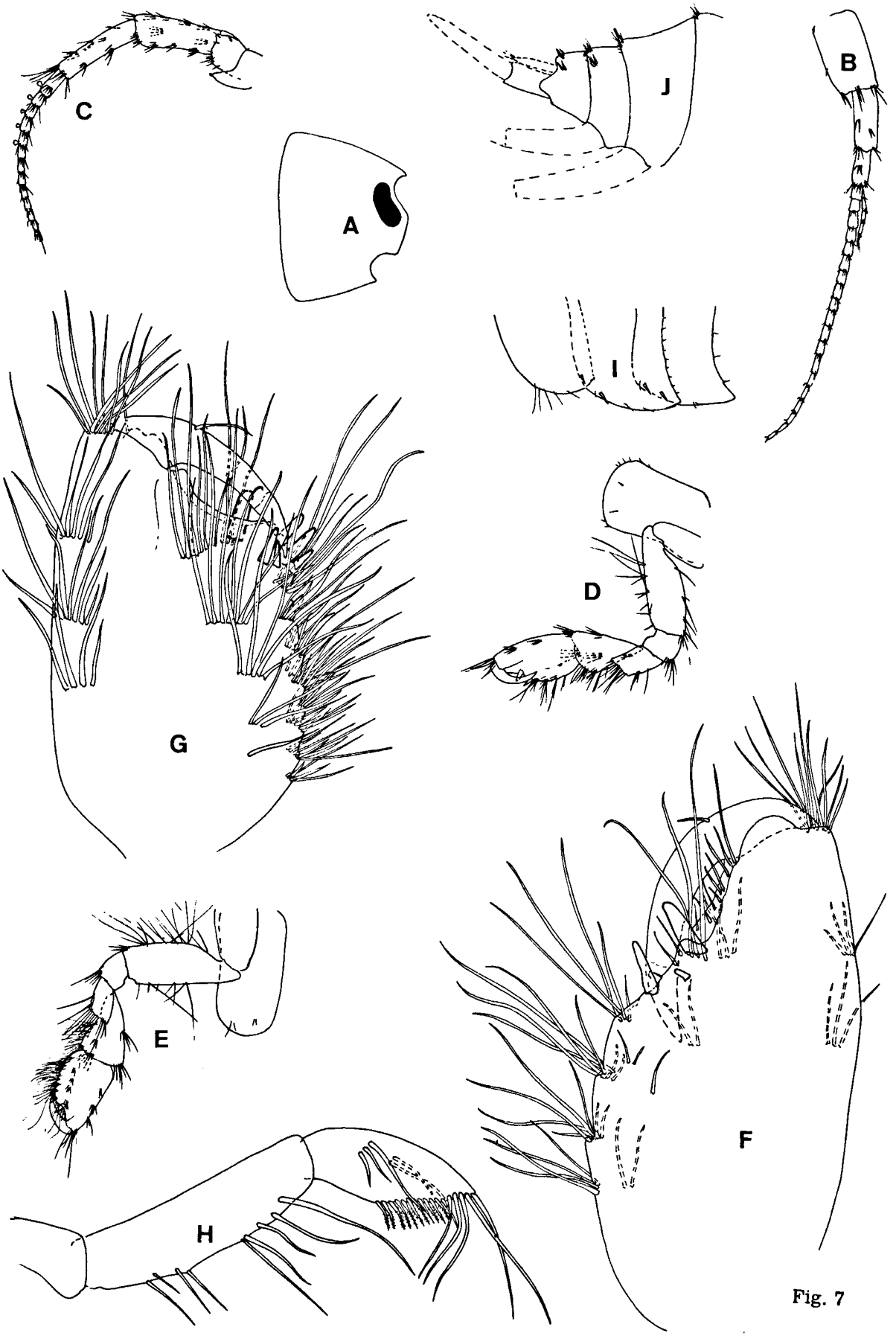


Fig. 7

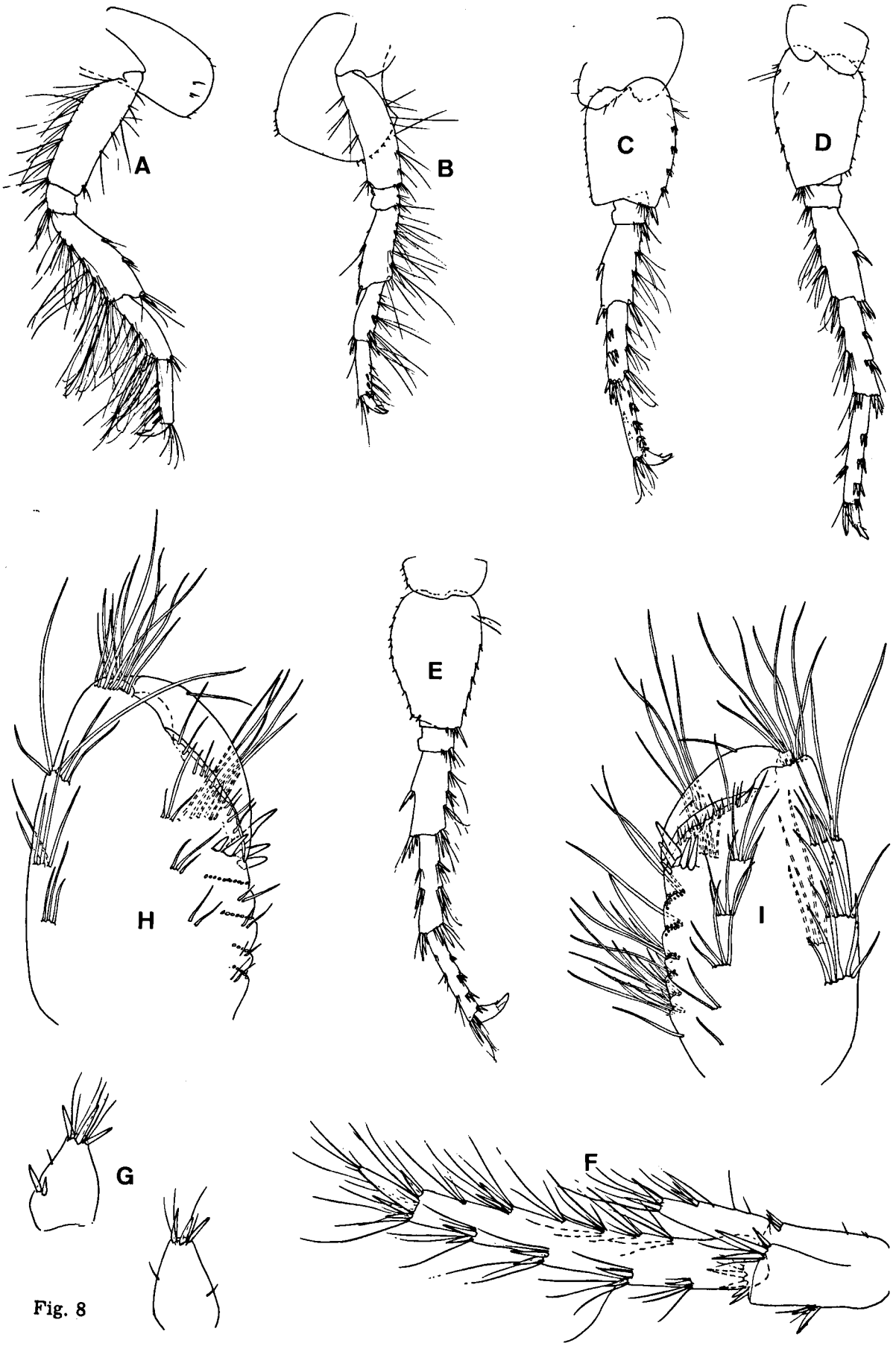


Fig. 8

Fig. 1. Echinogammarus simoni (Chevreux, 1894), ♂, from Djelfa, Algeria. A, head (scale 1); B, first antenna (1); C, second antenna (2); D, mandible palp (3); E, third leg (1); F, fourth leg (1); G, fifth leg (1); H, third uropod (2); I, telson lobe (3); J, urosome and epimeral plates (1);

Fig. 2. A - D, Echinogammarus simoni (Chevreux, 1894), ♂, from Djelfa, Algeria. A, first leg (scale 2); B, second leg (2); C, sixth leg (1); D, seventh leg (1).
E - J, Echinogammarus lochites (Margalef, 1956), ♂, from the type - locality (Sierra de Cazorla, Spain).
E, fifth leg (1); F, sixth leg (1); G, seventh leg (1); H, third uropod (2); I, telson (2); J, epimeral plates (1);

Fig. 3. Echinogammarus lochites (Margalef, 1956), ♂, from the type - locality (Sierra de Cazorla, Spain).
A, head (scale 1); B, first antenna (1); C, second antenna (1); D, mandible palp (2); E, first leg (1); F, second leg (1); G, palm of first hand (3); H, palm of second hand (3); I, third leg (1); J, fourth leg (1);

Fig. 4. Echinogammarus obtusidens nov. spec., ♂, from the type - locality (Almodovar, Spain).
A, head (scale 4); B, first antenna (1); C, second antenna (2); D, mandible palp (2); E, palm of first hand (3); F, third uropod (2); G, telson (2); H, urosome (4); I, epimeral plates (4).

Fig. 5. Echinogammarus obtusidens nov. spec., ♂, from the type - locality (Almodovar, Spain).
A, first leg (scale); B, second leg (1); C, palm of second hand (3); D, third leg (1); E, fourth leg (1); F, fifth leg (1); G, sixth leg (1); H, seventh leg (1).

Fig. 6. Echinogammarus tacapensis (Chevreux & Gauthier, 1924), ♂, from Berda, Tunisia. A, head (scale 1 ; B, first antenna (2); C, second antenna (2); D, mandible palp (3); E, first leg (2); F, second leg (2); G, third leg (1); H, fourth leg (1); I, fifth leg (1); J, sixth leg (1); K, seventh leg (1); L, third uropod (2); M, telson (3); N, metasome, urosome and epimeral plates (1); O, first antenna of very old male, detail (2);

Fig. 7. Echinogammarus lusitanus (Schellenberg, 1943), ♂, from the type - locality (Lugar de Mantelaēs, Portugal).
A, head (scale 1); B, first antenna (1); C, second antenna (1); D, first leg (1); E, second leg (1); F, hand of first leg (3); G, hand of second leg (3); H, mandible palp (3); I, epimeral plates (1); J, urosome (1).

Fig. 8. Echinogammarus lusitanus (Schellenberg, 1943).
A - G, ♂ and H - I, ♀, from the type - locality (Lugar de Mantelaēs, Portugal). A, third leg (scale 1); B, fourth leg (1); C, fifth leg (1); D, sixth leg (1); E, seventh leg (1); F, third uropod (2); G, telson lobes (2); H, hand of first leg (3); I, hand of second leg (3).