THE NON-MARINE GAMMARIDS OF THE BALEARIC ISLANDS

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1.—INTRODUCTION

The Gammaridae of the Balearic islands have been studied in detail by Margalef (1944, 1950a, 1950b, 1951a, 1951b, 1952a, 1952b, 1953a, 1953b). During the last few years, the Zoölogisch Museum, Amsterdam (Z. M. A.) acquired several collections of gammarids from the islands, partly through the field activities of some of its staff members, partly also from other sources.

In Margalef's papers, the following limnic species are recorded from the islands in question: *Metacrangonyx longipes* Chevreux *) from Mallorca and Menorca, *Echinogammarus eisentrauti* (Schellenberg) from Mallorca, *E. klaptoczi* ssp. *ebusitanus* Margalef from Ibiza, and *E. pungens* ssp. *minoricensis* Margalef from Menorca.

In the present paper, all limnic Gammaridae (s. str.) from the Balearic islands will be re-described, including a new *Echinogammarus (E. sicilianus* ssp. *monomerus)* from Mallorca. *Echinogammarus klaptoczi* is recorded not only from Ibiza, but also from Menorca, and will be compared witr populations from Malta and Tripolitania.

(*) Bousfield, 1977, recently removed **Metacrangonyx** from the Gammaridae to anoteher family, the Hadziidae. Although I do not see sufficient ground for incorporation in the Hadziidae, I agree with Bousfield that **Metacrangonyx** is realively remotely related to the **Gammarus** group.

It is noteworthy that the two limnic gammarids known from Mallorca have close relatives (differentiated on subspecific level) on Sicily. The gammarid fauna of Menorca es related to that of other Mediterranean islands and the European and African continents. From Ibiza only one, widely distributed, species is known.

Mixohaline gammarids have also been recorded from the islands, but no endemics occur in this group. It has long been thought that the form described as *Porrassia mallorquensis* by Marcus, 1912, was a special endemic of Mallorca, but it was recently shown (Stock, 1976) to be a juvenile form of an *Orchestia,* a well-known and widely distributed member of another family.

The following brackish water gammarids have been found in the Balearic islands: *Gammarus aequicauda* (Martynov, 1931), *G. insensibilis* Stock, 1956, *Echinogammarus foxi* (Schellenberg, 1928), and *Rhipidogammarus rhipidiophorus* (Catta, 1878). *Gammarus aequicauda* is known from several places on Mallorca (see Margalef, 1951b, 1953a, 1953b) and Menorca (Algayarens, Albufera, mouth of river d'en Revull near Sta. Galdana, Son Bou, El Grau; vide Margalef, 1951b, 1952b, 1953a, and unpublished records in Z. M. A.). *Gammarus insensibilis* has been found in brackish karst sources in the Torrent de Pareis, Mallorca. *Echinogammarus foxi* has been found in the same sources, whereas *Rhipidogammarus rhipidiophorus* was found in gravel of pools in the dry bed of the Torrent de Pareis. These three species are all new to the islands.

All these mixohaline gammarid species have a wide distribution in similar biotopes around the Mediterranean basin. Since they do not present any special interest they will not be treated in the sequel.

2.—THE ORIGIN OF THE BALEARIC GAMMARID FAUNA

It has been stressed repeatedly that gammarids are no doubt of marine origin and that they have invaded in several successive waves and during different geological periods the continental waters. In this process, a number of forms got gradually adapted to subterranean conditions; especially the older invasion waves underwent this fate when the surface waters disappeared during periods of drought or severe cold. With the re-appearance of surface

waters, new invasion waves came from the marine environment and adapted to brackish and later also ti limnic conditions. Assuming this picture of the evolution of the group is correct, the «oldest» invasion waves must be found in hypogean waters, and thus must have reduced or lacking, eyes, and must show an «old» distribution pattern (e. g., they must occur in a number of areas since long separated by sea-water, or they must show a Tethyan distribution pattern). This has quite frenquently been proven, e. g. in the Hadziidae or in *Pseudoniphargus.*

Less old invasion waves, but which still have had a considerable time for adaptation to limnic conditions, have small but distinct eyes. Examples of such forms are members of the *Gammarus pulex*-group and those of the *Echinogammarus simoni*-group. Several of these forms have acquired a large distribution, since they had ample time to disperse, and found an empty niche in the re-appearing surface waters after periods of drought or cold.

The most recent invasion waves are still often found in brackish waters, or when found in fresh water, they have retained osmoregulatory capacities to live in more saline waters (see for instance Vincent, 1971). Moreover, these forms have retained the large eye also found in their marine ancestors. Large eyes in combination with great osmoregulatory capacities are found for instance in *Echinogammarus berilloni,* in members of the *E. pungens*-group and in *Gammarus duebeni.* Several forms belonging to this category have a wide distribution in brackish waters, but only a limited distribution in fresh waters, partly because their penetration into the limnic environment was a relatively recent one, giving them not enough time to disperse any wider partly because they met other immigrants in these waters, hindering their dispersal through competition.

In the fauna of the Balearic islands, each of these three categories is present.

Metacrangonyx longipes Chevreux, is a blind species, first described from Mallorca, but lateron also found in Menorca (Chevreux, 1909; Margalef, 1952a; 1952b; Strinati & Coiffait,1961). The record of this species from Morocco (Balazuc & Angelier, 1951: 311, footnote) was corrected by Balazuc & Ruffo, 1954, who described the African specimens as a new species.

A small-eyed species in the Balearic limnic fauna is the widely distributed *Echinogammarus klaptoczi.* It is presumed that this species has acquired its actual distribution before he present-day insular areas became separated by sea-water.

The islands harbour 3 large-eyed species presumed to have evolved rather recently; in accordance with this thought is that all three have very limited ranges: *Echinogammarus eisentrauti* is known from a small stretch on the North coast of Mallorca, *E. sicilianus monomerus* is known from a single spring on Mallorca, and *E. pungens minoricensis* is recorded only from one valley on Menorca.

In contradistinction to the limnic gammarids, the mixohaline species all are widely distributed around the Mediterranean basin. Most of these species are epigean and have large eyes, except for *Rhipidopammarus rhipidiophorus,* that inhabits coarse interstitia and has small eyes, and that probably represents an older invasion wave.

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4.—THE GAMMARIDS OF MALLORCA

Echinogammarus sicilianus Karaman & Tibaldi, 1973,
monomerus n. ssp. Figs. 1-23.

Material examined.—1 (holotype), 100 paratypes. Mallorca, Font de Ca'n Topa, just N. of Coll de Sóller, on the W.-side of road C 711; a small, slowly flowing spring captured in a trough of natural stone; altitude 800-900 m; Sep. 9, 1975; vegetation consisting of *Chara.* Accompanying fauna: Acari, *Pisidium, Asellus,* Gastropoda, Hirudinea, insect larvae. The

type material has been preserved in the Zoölogisch Museum, Amsterdam, cat. no. Amph. 106.140.

Description.—Male: Maximum length about 7 mm. The eyes are well-pigmented, reniform and elongate (fig. 1); the distance from the mid-dorsal line of the head to the upper margin of the eye is smaller than the length of the eye. The lateral head lobes (fig. 1) are rounded. The dorsum of the metasome bears some minute setules at the posterior margin of the somites. The armature of the urosome (fig. 16) is characteristic: somite 1 bears medial elements only, somites 2 and 3 bear medial and lateral groups of elements; the elements of somite 1 consist solely of setae; on somites 2 and 3 spines and setae are found; the armature of somite 1 is 0-4-0; of somite 2 it is II+0 (or II+1) : II+1 : II+0 (or II+1); of somite 3 it is II (or III) : 2 : II (or III). The dorsal contour of the urosome (fig. 16) is flat, without humps and without saddle.

The first antenna (fig. 2) is about half as long as the body; it has rather slender peduncle segments. Peduncle segment 3 is 2.9 x as long as wide and bears 3 groups of setae on its ventral margin (including the disto-ventral group). The main flagellum is long, consisting of 20 to 25 segments. The peduncle is armed with a number of setae that are longer than the diameter of the segments; small numbers of setae are also present on the flagellum, but taken all together the antennule does not make a very «hairy» impression. The accessory flagellum is 4-segmented.

The second antenna (fig. 3) is markedly shorter than the first and is rather «hairy». The gland cone is tapering, straight, and almost as long as segment 3. Most setae are implanted on segment 4 (4 ventral, 3 medial and 5 dorsal groups) and segment 5 (6 ventral and 5 dorsal groups); the longest setae are about twice as long as the diameter of the segment on which they are implanted. The flagellum is short, consisting of some 10 segments; segments 2, 3, and 4 bear calceoli; several long setae are inserted on the proximal flagellar segments in particular.

The mandible palp (fig. 4) has an unarmed first segment; segment 2 is rather swollen, it bears 2 ventral rows of setae, a proximal row of unadorned setae, partly overlapping with a distal row of graduated, barbed setae; the third segment bears 2 groups of A-setae, 2 groups of B-setae, no C-setae, a regular row of some 15 D-setae of a size, and 4 E-setae.

Remaining mouth-parts without particulars.

The first gnathopod (fig. 5) has a roundedly rectangular coxal plate, the anterior margin of which bears several (c. 7) setules; the ventral margin of the coxal plate has a bare spot in the middle; the posterior margin bears some setules. The propodus (fig. 6) is tapering; the palm is oblique; the palmar angle is indicated by 2 large spines (proximad of which 2 smaller spines are implanted) and 2 small spines; the mid-palmar spine is well-separated from the angle group; sometimes 2 mid-palmar spines are found.

The second gnathopod (fig. 7) has a narrow coxal plate, with setules along the inferior and anteroinferior margins. The propodus (fig. 8) is larger than in gnathopod 1; the palm is not very oblique; the palmar angle is marked by 3 graduated spines and 2 smaller spines; the mid-palmar spine is tall, pointed, and clearly separated from the angle group.

The third pereiopod (fig. 10) has a coxal plate whose inferior margin is curved, bearing a posterior and an anterior group of setules; long, noncurly, setae are implanted on the merus and carpus; the latter segment also bears some spines.

The fourth pereiopod (fig. 11) has a coxal plate which is almost as long as wide, and which is devoid of setules in the central stretch of its straight inferior margin. The setae on merus and carpus are long and straight, though shorter than in P3.

The fifth pereiopod (fig. 12) has a more or less rectangular basis, the posterior margin of which bears some 10 to 14 short setae; the posterodistal corner is projecting; at some distance of the margin, on the inner surface of the article, a spine and some setules are borne. The merus and carpus bear 5 groups of long setae, sometimes mixed with long spines, on their anterior margin. Propodus elongate.

The basis of the sixth pereiopod (fig. 13) is more elongate than that of the 5th; its posterodistal corner is not produced, and bears no spines or setae on the interior surface; the setae on the posterior margin of the basis are longer than in P5.

The seventh pereiopod (fig. 14) resembles he 6th; the setae on the posterior margin of the basis are slightly longer than in P6, and the posterodistal corner bears a marginal spine absent in P6. The setae on merus and carpus are long.

The first epimere is rounded; the second has a rectangular posterior corner; the third has a slightly acute posterior corner (figs. 18-20). The inferior margin of plates 2 and 3 bears a number of long setae, that occupy the entire length of the margin.

The third uropod (fig. 21) has a long, 1-segmented exopodite, and a short, scale-like, 1-segmented endopodite. The outer margin of the exopodite bears 2 groups of spines, and 4 groups of setae, the majority of which is naked. The distal margin of the exopodite bears 6 spines and 8 to 12 long setae, all naked (fig. 23); sometimes, one of the distal spines has a short basal socle, which looks like (or which actually is) a vestige of the 2nd exopodite article (fig. 22). The inner margin of the exopodite is provided with a number of solitary, plumose setae and with 1 group of spines.

The telson (fig. 17) consists of 2 elongate lobes, each with a lateral, naked setule, with 2 subdistal sensory setules, usually with 2 distal spines, 1 or 2 short distal setules and 1 or 2 longer, naked setae.

Female: very similar to the male. The second antenna is devoid of calceoli and is slightly less «hairy». The propodus of gnathopod 2 (fig. 9) is slightly wider in its proximal part and the setae on its posterior margin are shorter than in male.

Variability.—A slight variability has been observed in the armature of the urosome: the number of spines and setae in each group may fluctuate. The first urosomite always lacks lateral groups of elements; its mediodorsal group always consists of setae, except in one male which had a single spine amongst the setae. On the distal margin of the exopodite of uropod 3, a vestigial 2nd exopodite segment (in the form of a socle of one of the spines) might be discernible or lacking.

Affinities.—The present taxon belongs to the genus *Echinogammarus,* more in particular to the sectio «*glabra*» (sensu Schellenberg, 1937), i.e.

without conspicuous armature (teeth, long setae or spines) on the dorsal surface of the metasome. Actually, 34 species or subspecies are known to me that belong to this section. According to the morphology of its 3rd uropod (exopodite segment 2 vestigial or absent), the animals from Mallorca are closely related to *E. sicilianus* Karaman & Tibaldi, 1973. Many other characters in its morphology point in the same direction (e.g., the shape of the eye, the absence of a compressed elevation on urosomite 1, the relative length of peduncle segment 3 of A1, the setosity of the antennae, the ornamentation of the coxal plates 1 to 4, the relative length of the merus in P4-P7, the length of the setation on the merus and carpus of P5-P7, the length and number of the setae on the posterior margin of the basis in P7, the setosity of the epimeral plates, the armature of the telson).

On these morphological grounds, I consider the populations from Sicily and from Mallorca as subspecies; the Sicilian populations should be called *E. sicilianus sicilianus,* the Mallorcan ones are named *E. sicilianus monomerus**). It is clear that the two subspecies of *E. sicilianus* are closely related to *E. stammeri* (S. Karaman, 1931), more in particular to the form of *stammeri* described under the name of *fluminensis* Stock & Pinkster, 1970 (from Corsica, northern Italy and Grece) and ssp. *visualis* G. Karaman, 1974 (from southern Italy).

The main differences between the nominate form of *E. sicilianus* and the ssp. *monomerus* are the following: (1) the antennal gland cone of *monomerus* is longer; (2) the 3rd segment of the mandible palp bears 2 groups of A-setae in *monomerus* (5 to 6 in *sicilianus*); (3) the mid-palmar spine of gnathopods 1 and 2 in the male of *monomerus* is more widely separated from the angle group; (4) the basis of P5 has a subdistal spine on the inner surface in *monomerus* (only setae in *sicilianus*); (5) the first urosomite in *monomerus* bears a dorsal group of elements consisting of setae only (setae plus spines in *sicilianus*); (6) the inferior margin of epimeral plates 2 and 3 is less densely setose in *monomerus*; (7) the 2nd exopodite segment of uropod 3 is small but functional (= articulated) in *sicilianus,* vestigial (non-articulated) to absent in *monomerus*; (8) the lateral armature of the telson is reduced to 1 seta in *monomerus.*

(*) The proposed subspecific name alludes to the one-segmented condition of the exopodite of uropod 3.

Echinogammarus eisentrauti (Schellenberg. 1937).

Refs.: *Gammarus (Echinogrammarus) eisentrauti* Schellenberg, 1937: 278-280, fig. 4 (type-locality: Deyá, Mallorca).

Gammarus pungens subsp. *Einsentrauti*; Margalef, 1950a: 144-150, fig. 5; Margalef, 1950b: 26; Margalef, 1952b: 105.

Gammarus pungens subsp. *eisentrauti*; Margalef, 1952a: 249; Margalef, 1953a: 199; Margalef, 1953b: 106.

Echinogammarus eisentrauti; Stock, 1968: 30-33, figs. 5-6, non *Gammarus pungens* forma de Mallorca; Margalef, 1944: 201, figs. 10-14 (vide infra).

Material examined.—All from Mallorca:

—Source emerging from a cave, called Font de sa Menta (alongside road C 710, N. of Estallenchs); Sep. 7, 1975 and Apr. 14, 1969 (Z.M.A.).

—Captured source S. of road C 710, between Valldemossa and Deyá, near Mirador de ses Pites; Sep. 11, 1975 (Z.M.A.).

—Source near the cascade of Deyá, called Font Fresca; Sep. 11, 1975 (Z.M.A.).

Distribution.—Schellenberg erroneously considered the typelocality, Deyá (or Deiá), an island to the West of Mallorca («Insel Deja, westlich Mallorca»). This error was already corrected by Margalef, 1950a: 150; up to to-day, the species is abundant in the environments of Deyá.

In his 1950a paper, Margalef records a number of localities from which he has examined material. One of the localities is a bit vague: environments of Palma de Mallorca, along the road of Valldemosa. Since the species has never been found again near Palma (on the South coast of Mallorca), but is abundant near Valldemosa (= Valldemossa) on the North coast, some doubt exists about this record. As a matter of fact, all localities lie on a

small stretch on the North coast, between Estallenchs and the Monasterio de Lluch, and certainly not on «toda la isla», as Margalef, 1953a: 199 puts it.

Special mention deserves a single female specimen found near Artá (in the East of Mallorca), in the Torrente de Na Nyana, described and illustrated by Margalef, 1944, as «*Gammarus pungens* forma de Mallorca», but synonymized later (Margalef, 1950a: 150) with *E. eisentrauti*. However, the female specimen illustrated by Margalef, cannot be identical with that species. I base my opinion entirely on Margalef's figures, illustrating gnathopods 1 and 2, the merus and carpus of pereiopod 6, the 3rd uropod, and the telson. Gnathopod 1 is illustrated as having no palmar angle spines (three large palmar angle spines are present in *eisentrauti*, see fig. 27), and as having a single row of long setae on the palmar margin (instead of a proximal row of long setae and a distal row of short setae); also the high number (three) of dactylar setae is noteworthy (one in *eisentrauti*). Gnathopod 2 is illustrated having an elongated carpus, almost as long as the propodus (in ♀ *eisentrauti*, cf. fig. 28, the carpus is not elongated, and much shorter than the propodus); also the propodus itself is much more elongate in the female from Artá than in my material; the Artá specimen lacks palmar angle spines (four in *eisentrauti*) and has apparently one row of long setae on the palmar margin (instead of the small central group of long setae found in *eisentrauti*). The sixth pereiopod, as illustrated by Margalef, is much more slender, and much less strongly armed, than the corresponding appendage in ♀ *eisentrauti* (cf. fig. 36). The third uropod is shown with an unarmed endopodite (armed with terminal spines in *eisentrauti*, cf. fig. 38), and with a slender, one-segmented exopodite (less slender and 2-segmented in *eisentrauti*, cf. fig. 37). On the basis of these differences, it is hard to believe that the Artá material can be identified with *E. eisentrauti*.

Summarizing, *E. eisentrauti* is only known with certaintry from the slopes of the northern mountain ridge on Mallorca. The other localities («on the road of Valldemossa» and «Artá») need confirmation.

Remarks.—This species is morphologically very similar to *E. adipatus* Karaman & Tibaldi, 1973, from Sicily. The chief differences are found in the slightly longer setation on the posterior margin of the basis of P7 ♂,

and the somewhat wider shape of this segment. The coxal plates 1 to 4 bear fewer and shorter setae on the inferior margin in *E. adipatus*. The armature of the telson, considered a diagnostic character by Karaman & Tibaldi, 1973, and even a key character by G. Karaman, 1974: 101, is too variable to be of much use. In my material of *eisentrauti* the number of lateral spines is 1 or more rarely 2, and the number of terminal spines is usually 3. In material of *adipatus* from different localities on Sicily, preserved in ZMA, the number of lateral telson spines varies between 1 and 3, and the number of distal spines between 3 and 5. In fig. X(1) of Karaman & Tibaldi's paper, palp segment 2 of the mandible in *adipatus* is shown with numerous setae all over its length. In the Sicilian material at my disposal, the proximal group of elements on this segment may be reduced to 5 setae only, so not differing much in this respect from the situation found in *E. eisentrauti.*

Tentatively it is suggested, on morphological grounds, that *adipatus* might be considered a subspecies of *E. eisentrauti.*

A couple of new figures of *E. eisentrauti* have been incorporated in the present paper, partly to supplement the earlier drawings of Margalef (1950a) and Stock (1968), partly to show the differences between ♀ *eisentrauti* and the «female from Artá».

5.—THE GAMMARIDS OF IBIZA AND MENORCA

Echinogammarus klaptoczi Schäferna, 1908. Figs. 39-73.

Echinogammarus klaptoczi Schäferna, 1908: 449-451, pl. 30.

Gammarus klaptoczi subsp. *ebusitanus* Margalef, 1951a: 64-68, fig. 6 b-i (nov. syn.).

This species was described, and carefully figured, by Schäferna after numerous specimens found in small pools fed by a spring, running also in summer near Mimuna, E. to N.E. of Gharian (Tripolitania, Libya).

In 1951, Margalef described a very similar gammarid, found in running waters of irrigation channels («Feixes») of Ibiza. In his opinion, the higher number of setae and spines on the dorsal surface of the abdominal somites, and the lower number of setae on the telson, justified the creation of a separate subspecies for the Ibiza population, which he called *E. klaptoczi ebusitanus.*

I have had an opportunity to examine samples of *E. klaptoczi* from the following localities:

— Libya: Tripolis, oasis Zavia (collection G. S. Karaman, Titograd).

— Malta: Xlendi Valley, downstream of Fontana; Apr. 15, 1974; leg. U. Schiecke (collection Museo cívico di Storia naturale, Verona).

— Ibiza: in the ditches, July 1, 1913; leg. Sz. Tenenbaum (collection Lodz University).

— Ibiza: Las Feixes; May 31, 1950; type-specimens of Margalef's subspecies *ebusitanus* (collection R. Margalef, Barcelona).

— Menorca: in a stream called To ente de Bulé, near Playa Son Bou; Apr. 30, 1975; leg. J. Coosen & L. Erwteman (collection Z.M.A.).

After dissection, and careful comparison, of all this material, I have found no reason to segregate the various populations into different taxa. Inside every population, the variation is rather large, and the differences between the various populations, if any, fall entirely within the variation range.

In the sequel, the populations found in the Balearic islands will be redescribed and compared with the samples from Libya and Malta.

Re-description of *E. klaptoczi,* mainly based on Ibiza specimens.

Body length up to 7 mm. Lateral head lobes truncated, sinus rather shallow (fig. 39). Size of the eye variable: in some specimens the eye is rather elongate (fig. 63), in others it is much shorter (fig. 64). Margalef,

1951a, supposed this to be a sexual difference, but in my material such a link with the sexes was not obvious. The Maltese and Tripolitanan populations have a rather small eye (figs. 60, 61); in the Menorcan specimens the eye is slightly wider than in the Ibiza specimens (fig. 62), but the length of the eye is variable.

The dorsum of the mesosome is smooth and unarmed. The metaand urosome bear dorsal and dorsolateral groups of elements, consisting of short spines and equally short setules (fig. 45). The number of elements per group varies widely, but the following configuration is often seen:

Metasomite	I	1: III or IV: 1
»	II	1 or 2: IV to VI + 1: 1 or 2
»	III	III + 1 to 5: III to VI: III + 1 to 5
Urosomite	I	I: II + 2: I
»	II	II: II + 0 to 4: II
»	III	0: I + 1: 0

The first antenna (fig. 40) has an almost glabrous basal segment; the length of segment 2 is about 70 % of that of segment 1, that of segment 3 is 35-40 % of segment 1. The flagellum consists of up to 29 segments in my specimens from Ibiza (Tripolitania: 22; Malta: 28; Menorca: 31). Both pedunculus and flagellum bear a low number of short setae. Accessory flagellum (fig. 40) 1 —or 2— segmented (in the latter case, the 2nd segment is almost vestigial), shorter than the first flagellum article.

Te second antenna (fig. 41) has a short, straight gland cone. Segment 5 is longer and more slender than segment 4. The inferior margin of segment 5 bears 6 or 7 groups of setae, which are not much longer than the diameter of the segment. Flagellum 10 —to 13— segmented; armed with a low number of setae; calceoli absent in both sexes.

The mandible palp (fig. 42) is remarkably uniform in all populations studied. The basal segment in unarmed; segment 2 bears a proximal group consisting of a few, usually 2, setae, and a distal group consisting of 2 rows of longer setae. Segment 3 bears a regular row of numerous D-setae, one group of A-setae one group of B-setae, and 4 (Ibiza, Menorca) or 5 (Malta, Libya) E-setae.

Gnathopod 1 with a rectangular coxal plate (fig. 58), the anteroventral corner of which is crenulated and provided with several short setules; the ventral margin of the coxal plate has a short unarmed stretch. The propodus (♂) has an elongate oval outline (fig. 46); palm very oblique. Armature of the palmar margin somewhat variable: within each population one can find 2 + 1, 3 + 1, or 4 + 1 pointed palmar angle spines; on a short distance of the angle group, a truncate mid-palmar spine is invariably present (fig. 48). Claw with 1, more rarely with 2, setules on the external margin.

Gnathopod 2: coxal plate armed as plate 1 (fig. 59). Propodus larger and more restangular than that of gnathopod 1 (fig. 47). Palm (♂) not very oblique (fig. 49); mid-palmar spine truncate, well-separated from the angle group of spines; these pointed angle spines are variable in number (3 + 0, 3 + 1, or 3 + 2).

Third pereiopod (fig. 55): coxal plate with 4 or 5 setules on the anteroventral and posteroventral corners and a bare stretch in between.

The armature of coxal plate 4 (fig 56) is similar to that of plate 3.

The basis of the fifth pereiopod (fig. 50) is rectangular; the posteroventral corner is unarmed, slightly projecting; the posterior margin is slightly crenulated and armed with some 10 short setules. The merus bears 1 or 2 groups of spines on the posterior margin.

The basis of the sixth pereiopod (fig. 57) is tapering; the posteroventral corner is armed with a spine, but is not projecting; the posterior margin is armed with short setules.

The basis of pereiopod 7 (fig. 52) is tapering; the posteroventral corner is armed with several spines, but is not projecting; the posterior margin bears about 10 short setules, and several longer submarginal setae. The merus and carpus of P5, P6, and P7 are armed with strong spines; setae are almost completely lacking, those present are not overreaching the spines. The length of the spines on the propodus is greater in the Tripolitanian population than in the other material.

Epimeral plate 1 (figs. 66-71) with a rounded inferior margin, anteriorly armed with 2 or 3 long setae, posteriorly produced into a fine point.

Epimeral plate 2 (figs. 66-71) with produced posteroventral corner; within the Ibiza population one can find individuals with a feebly (fig. 71) as well as ith a strongly (fig. 70) produced corner. The ventral margin of the plate bears a varying number (1 to 3) anterior spines, a number of shorter (Ibiza) or longer (Menorca, Malta, Tripolis) setae, and a varying number (Tripolis and Menorca: 0; Ibiza and Malta: 0 to 2) posterior spines. The posterior margin bears 1 to 4 setules.

Epimeral plate 3 (figs. 66-71) is strongly pointed (Ibiza, figs. 70,71) or feebly pointed (Malta, figs. 68, 69); the Tripolitanian and Menorcan populations occupy and intermediate position in this respect (figs. 66, 67). Ventral margin armed with a varying number (2 to 3 + 0 to 2) of anterior spines, and a varying number (0 to 2) of posterior setules. Posterior margin with 1 to 4 setules.

The third uropod (fig. 44) is of variable length. Exopod segment 1 is about 4 times as long as wide (Ibiza, Tripolis), or 4 to 5 times as long as wide (Malta, Menorca, fig. 65). The lateral and medial margins of the exopodite bear 3 or 4 groups of spines, and a small number of setae that are somewhat longer than the spines. The second exopodite segment is slender, fingershaped, longer than the distal spines of segment 1; it is distally armed with 4 setules. All uropod setae are glabrous. The endopodite is scale-like, short, distally armed with a spine and 1 or 2 setules.

The telson lobes are rather elongate. In the Tripolitanian material, usually 1 distal spine (accompanied by a seta) occurs, more rarely 2 spines (fig. 73); there are 3 lateral setules and 3 sensory setules. The other populations usually have 2 distal spines, and 0 to 2, but usually 3, sensory setules (figs. 53, 54, 72). In one specimen from Ibiza, a lateral spine instead of a seta was found (fig. 54). The setae are always at most about as long as the spines.

Echinogammarus pungens (H. Milne Edwards, 1840)
subsp. **minoricensis** (Margalef, 1952)

Refs.: *Gammarus pungens minoricensis* Margalef, 1952a: 249-250; Margalef, 1952b: 105-106; Margalef, 1953a: 199.

Material examined. - 25 specimens, Menorca, river d'en Revull, near Santa Galdana; Apr. 30, 1975; leg. J. Coosen & L. Erwteman (Z. M. A.).

Remarks. - Margalef (1952a) diagnosed the subspecies *minoricensisl* an endemic form from the Santa Galdana valley, Menorca, in a few lines only, but these lines contain sufficient elements to recognize the subspecies.

According to Margalef, the ssup. *minoricensis* is characterized by (1) a higher number of marginal setules on the coxel plates 1 to 4; (2) a shorter second exopodite segment in the third uropod; (3) shorter plumose setae on the first exopodite segment of the third uropod.

Ad 1). The marginal setation of the anterior coxal plates is no longer of use, since detailed descriptions of *E. pungens* from continental Europe (e. g., Stock, 1968; G. S. Karaman, 1969) prove that several of these populations have a high number of magrinal setules as well.

Ad 2). The second character appears to be useful. The distal exopodite segment of uropod 3 in ssp. *minoricensis* is about as long as the longest spines on exopodite segment 1. In ssp. *pungens,* the distal article overreaches distinctly the spines (cf. figs. 74 and 75).

Ad 3). Although the setation of the third uropod varies to some extent (populations from Yugoslavia are more densely setose than those from France), the Menorcan population is characterized by a low number of plumose setae (plumose setae are in the minority in comparison with naked setae; in continental populations this situation is reverse. The uropodal setae in the Menorcan populations are slightly shorter than in subsp. *pungens* (cf. figs. 74 and 75).

In addition, I have found the following differences between the subspecies *minoricensis* and *pungens:*

(4) The setae on the telson are shorter than, occasionally as long as, the spines in *minoricensis* (overreaching the spines in *pungens*) (cf. fig. 79).

(5) The dorsal setae on urosomites 1 to 3 are shorter than, or as long as, the spines in *minoricensis* (in *pungens* the setae are longer than the spines).

(6) The basis of the seventh pereiopod, though of the same shape in both subspecies, has shorter marginal setae in *minoricensis* (in the proximal part of the posterior margin, the setae are about as long as the distance separating the setae; cf. figs. 76 and 77).

(7) The posterodistal corner of the basis of P7 (♂, ♀) in *minoricensis* bears 2 or 3 spines (1 in *pungens*) (cf. figs. 76, 77, and 78).

Although the differences mentioned above are of relatively minor importance, their existence seems to substantiate Margalef's opinion that Menorcan populations are differentiated at subspecific level from the populations of southern France and Catalonia.

It should be stressed that the Menorcan population, unlike the material described by G. Karaman, 1974, from Italy, is devoid of spines on the dorsal and dorsodistal margin of peduncle segment 4 of the second antenna. In this respect, the Menorcan material agrees with that from S. France and Catalonia (Spain). Since also variation in the slenderness of the peduncular segments 4 and 5 of the second antenna occurs in certain continental populations, and since Yugoslavian populations have a much longer and denser setosity on the outer margin of uropod 3, it remains to be seen whether it is advisable to subdivide the *E. pungens* populations from the northern Mediterranean belt into different subspecies.

Figs. 1 - 9.

Echinogammarus sicilianus ssp. *monomerus* nov., paratypes. 1, head from the left, ♂ (scale a); 2, first antenna, ♂ (a); 3, second antenna, ♂ (a); 4, mandible palp, ♂ (b); 5, first gnathopod, ♂ (a); 6, propodus of same (b); 7, second gnathopod, ♂ (a); 8, propodus of same (b); 9, propodus of second gnathopod, ♀ (b).

Figs. 10 - 17.

Echinogammarus sicilianus ssp. *monomerus* nov., paratypes. 10, third pereiopod, ♂ (scale a); 11, fourth pereiopod, ♂ (a); fifth pereiopod, ♂ (a); 13, basal part of sixth pereiopod, ♂ (a); 14, seventh pereiopod, ♂ (a); 15, basis of seventh pereiopod, ♀ (a); 16, contour of urosome, ♂ , from the left (b); 17, telson, ♂ (b).

Figs. 18 - 23.

Echinogammarus scilianus ssp. *monomerus* nov., paratype, ♂ . 18, first epimeral plate, from the left (scale a); 19, second epimeral plate, from the left (a); 20, third epimeral plate, from the left (a); 21, third uropod (b); 22, tip of exopodite of third uropod, showing a vestigial 2nd article (c); 23, same, 2nd article entirely lacking (c).

Figs. 24 - 26.

Echinogammarus eisentrauti (Schellenberg, 1937), ♂ from Mallorca, Font de sa Menta.

24, head from the right (scale d); 25, mandible palp (e); 26, epimeres 1 to 3, from the right (d).

Figs. 27 - 33.

Echinogammarus eisentrauti (Schellenberg, 1937), from Mallorca, Font de sa Menta.

27, distal segments of gnathopod 1, ♀ (scale e); 28, distal segments of gnathopod 2, ♀ (e); 29, palmar margin of gnathopod 1, ♂ (e); 30, palmar margin of gnathopod 2, ♂ (e); 31, first antenna, ♂ (d); 32, oostegite of gnathopod 2, ♀ (d); 33, coxal plate 4, ♂ (d).

Figs. 34 - 38.

Echinogammarus eisentrauti (Schellenberg, 1937), from Mallorca, Font de sa Menta.

34, third pereiopod, ♂ (scale d); 35, fifth pereiopod, ♂ (d); 36, sixth pereiopod, ♀ (d); 37, third uropod, ♂ (b); 38, endopodite of third uropod, ♀ (b).

Figs. 39 - 44.

Echinogammarus klaptoczi Schäferna, 1908, ♂ from the «Feixes» of Ibiza.

39, head from the rigth (scale a); 40, first antenna (detail: accessory flagellum of another male) (d); 41, second antenna (d); 42, mandible palp (d); 43, epimeral plates 2 and 3, from the left (b); 44, third uropod (b).

Figs. 45 - 54.

Echinogammarus klaptoczi Schäferna, 1908, ♂ from the «Feixes» of Ibiza.

45, dorsal contour of meta- and urosome, from the left (scale a); 46, propodus of gnathopod 1 (b), propodus of gnathopod 2 (b); 48, palmar margin of gnathopod 1 (c); 49, palmar margin of gnathopod 2 (c); 50, fifth pereiopod (d); 51, claw of fifth pereiopod (e); 52, seventh pereiopod (d); 53, 54, left telson halves of two different specimens (c).

Figs. 55 - 59.

Echinogammarus klaptoczi Schäferna, 1908, ♂ from the «Feixes» of Ibiza.

55, third pereiopod (scale d); 56, fourth pereiopod (d); 57, sixth pereiopod (d); 58, first coxal plate (b); 59, second coxal plate (b).

Figs. 60 - 65.

Variability in different specimens of the same population, and in specimens from diferent populations of *Echinogammarus klaptoczi* (males).

60 - 64, head from the rigth, showing variation in the shape of the eye (60, Tripolis; 61, Malta; 62, Menorca; 63 and 64, Ibiza); all to scale b.

65, third uropod (Malta) (scale b).

Figs. 66 - 73.

Variability in different specimens of the same population, and in specimens from different populations of *Echinogammarus klaptoczi* (males).

66 - 71, epimeral plates, from the rigth (66, Tripolis; 67, Menorca; 68, 69, Malta; 70, 71, Ibiza).

Fig. 71 has been re-drawn after Margalef, 1951a. All to scale b.

72 - 73, telson (72, Menorca, scale b; 73, Tripolis, scale e).

Figs. 74 - 79.

Echinogammarus pungens (H. Milne Edwards, 1840).

74, 77: ssp. *pungens* from southern France (74, third uropod, ♂, scale f; 77, basis of seventh pereiopod, ♂ , scale g).

75, 76, 78, 79: ssp. *minoricensis* Margalef, 1952, from Santa Galdana valley, Menorca (75, third uropod, ♂ , scale f; 76, basis of seventh pereiopod, ♀ , scale g; 78, basis of seventh pereiopod, ♂ , scale f; 79, telson, ♂ , scale f).

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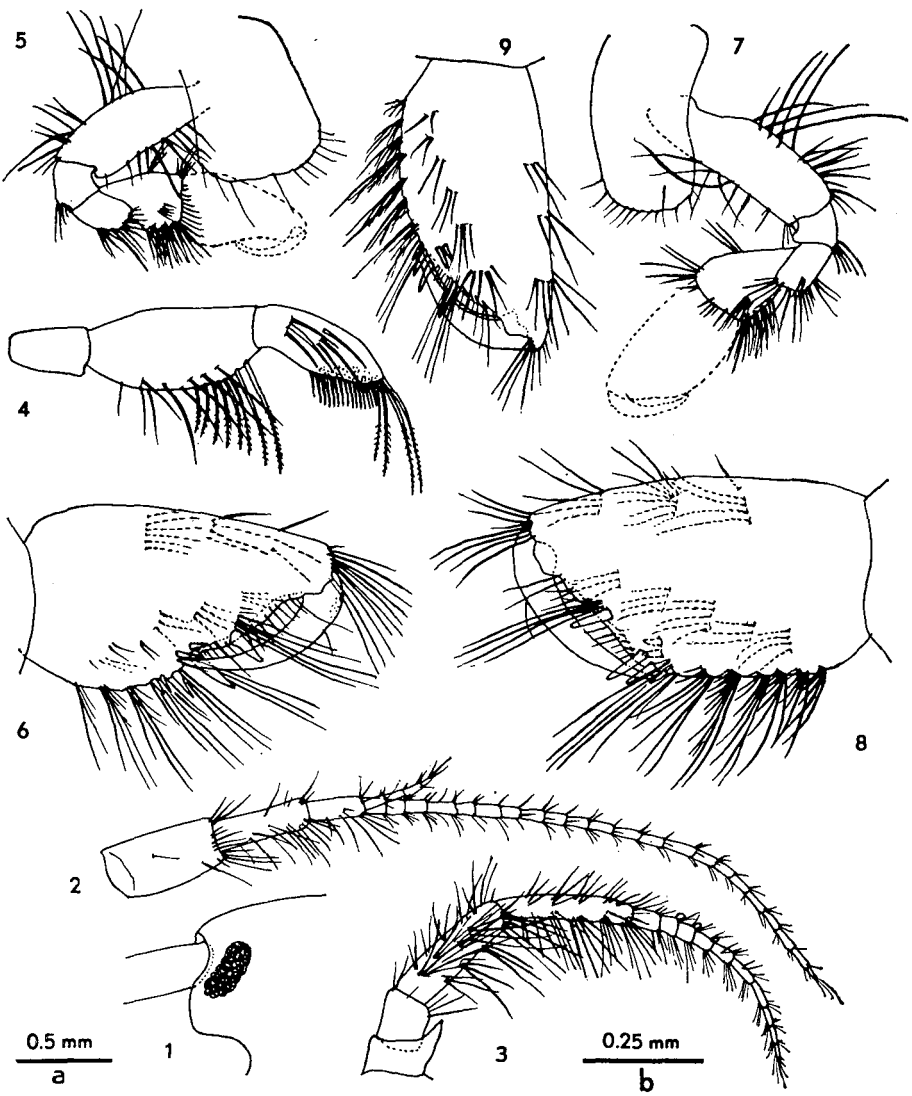
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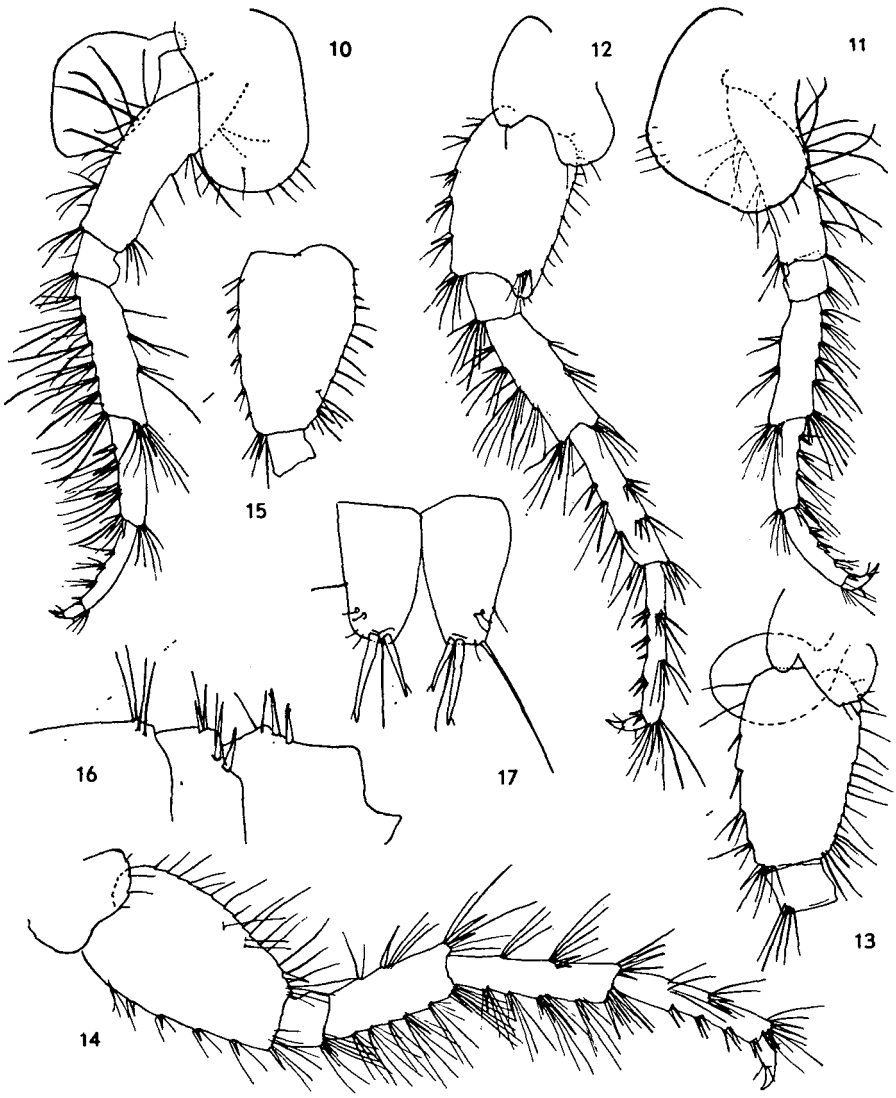
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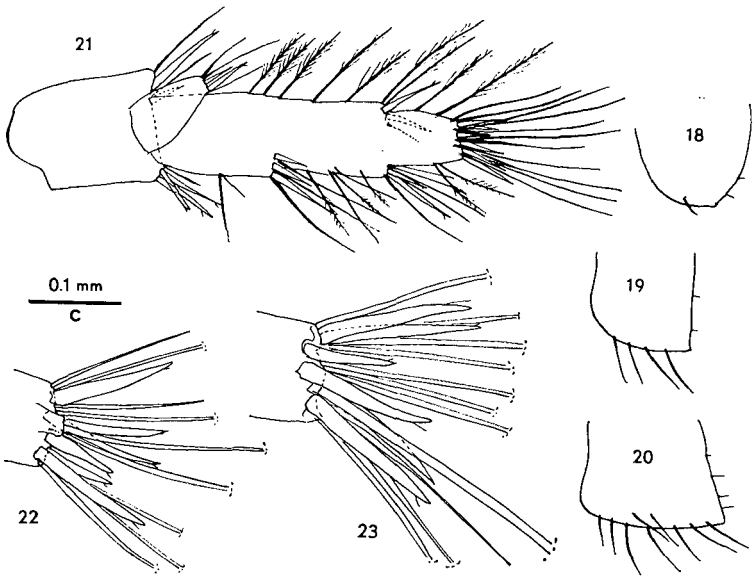
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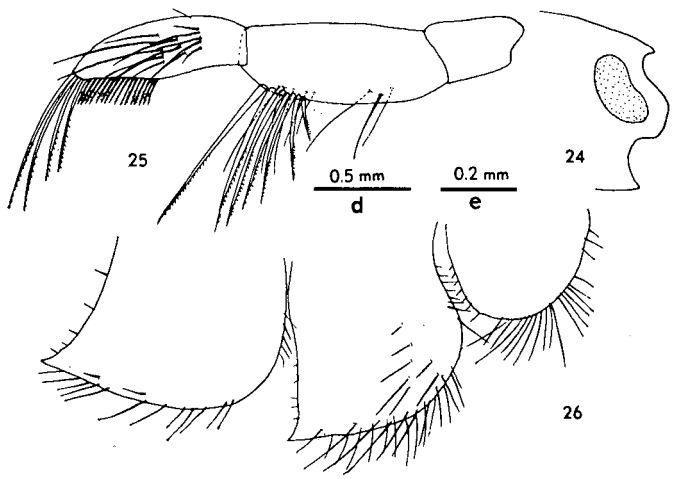
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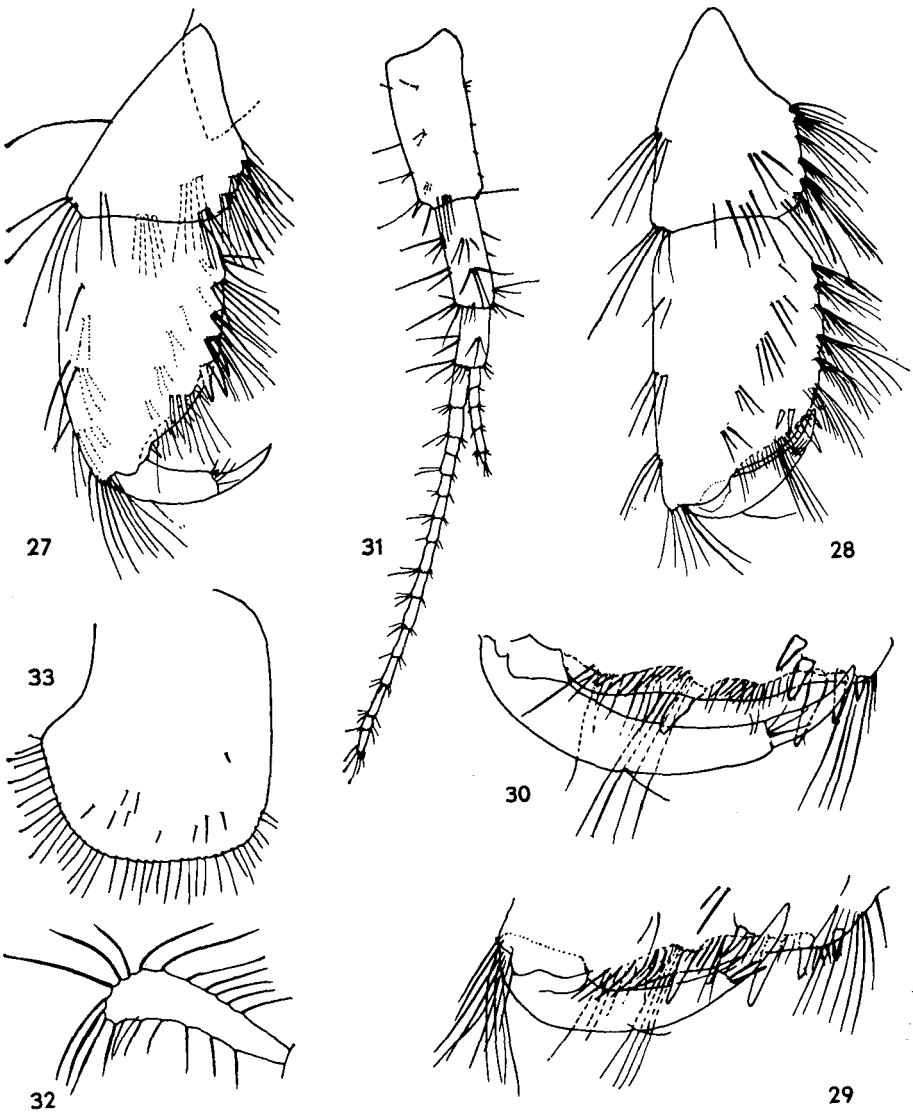
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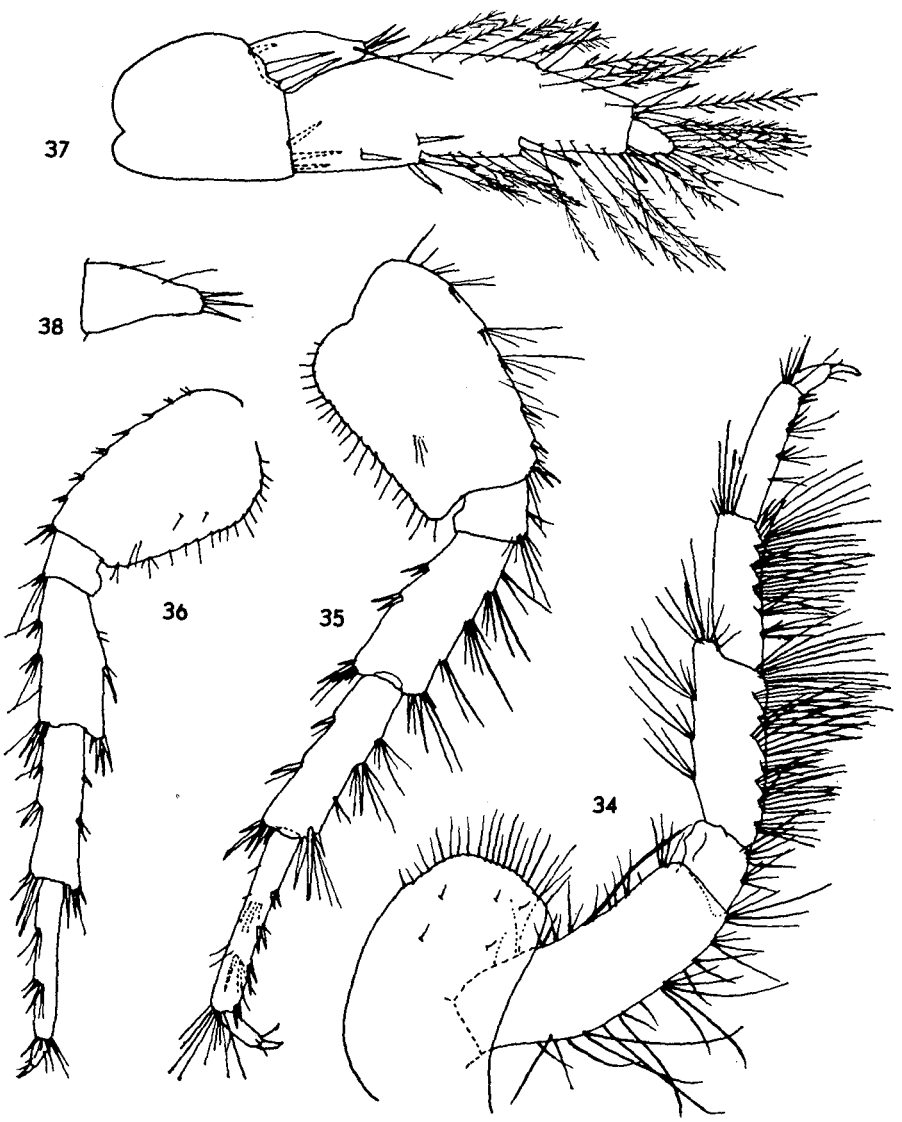
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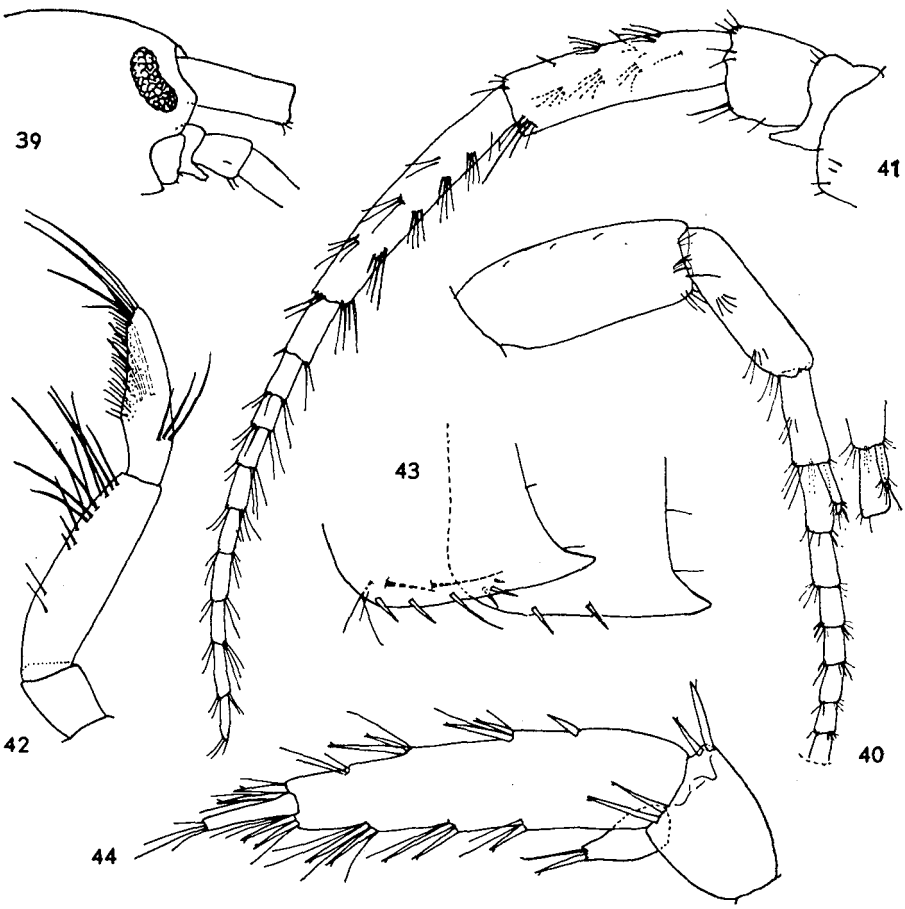
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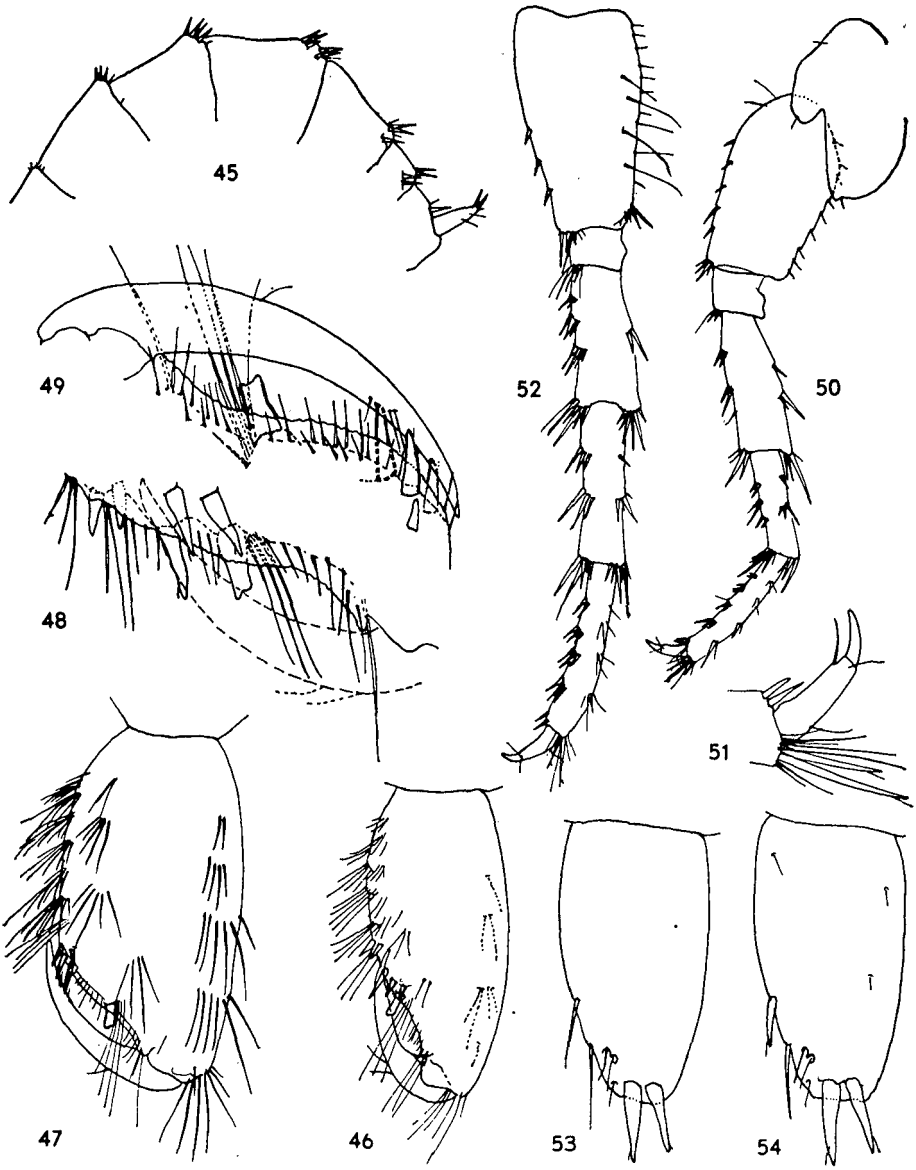
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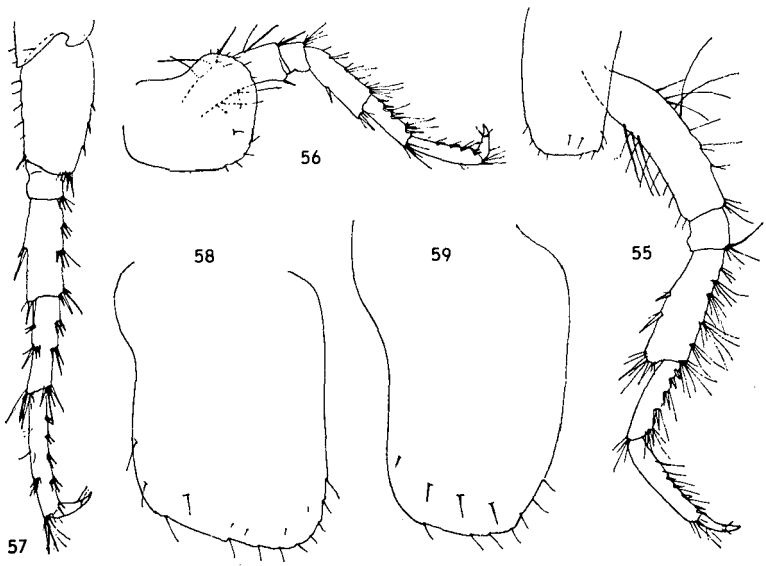
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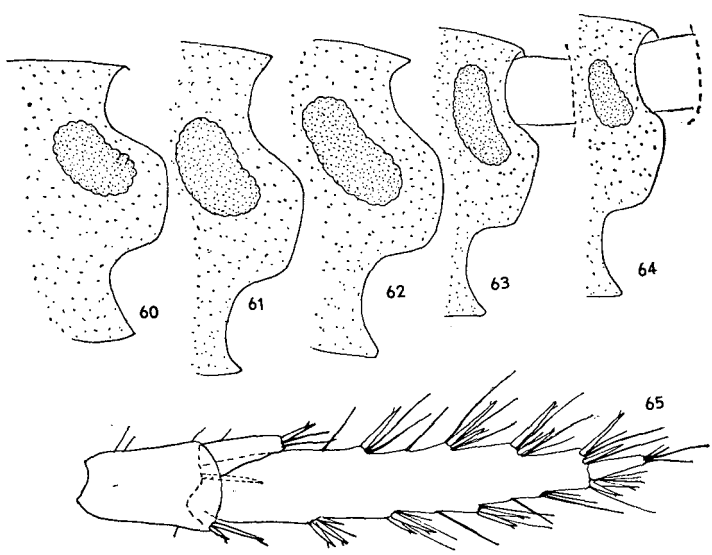
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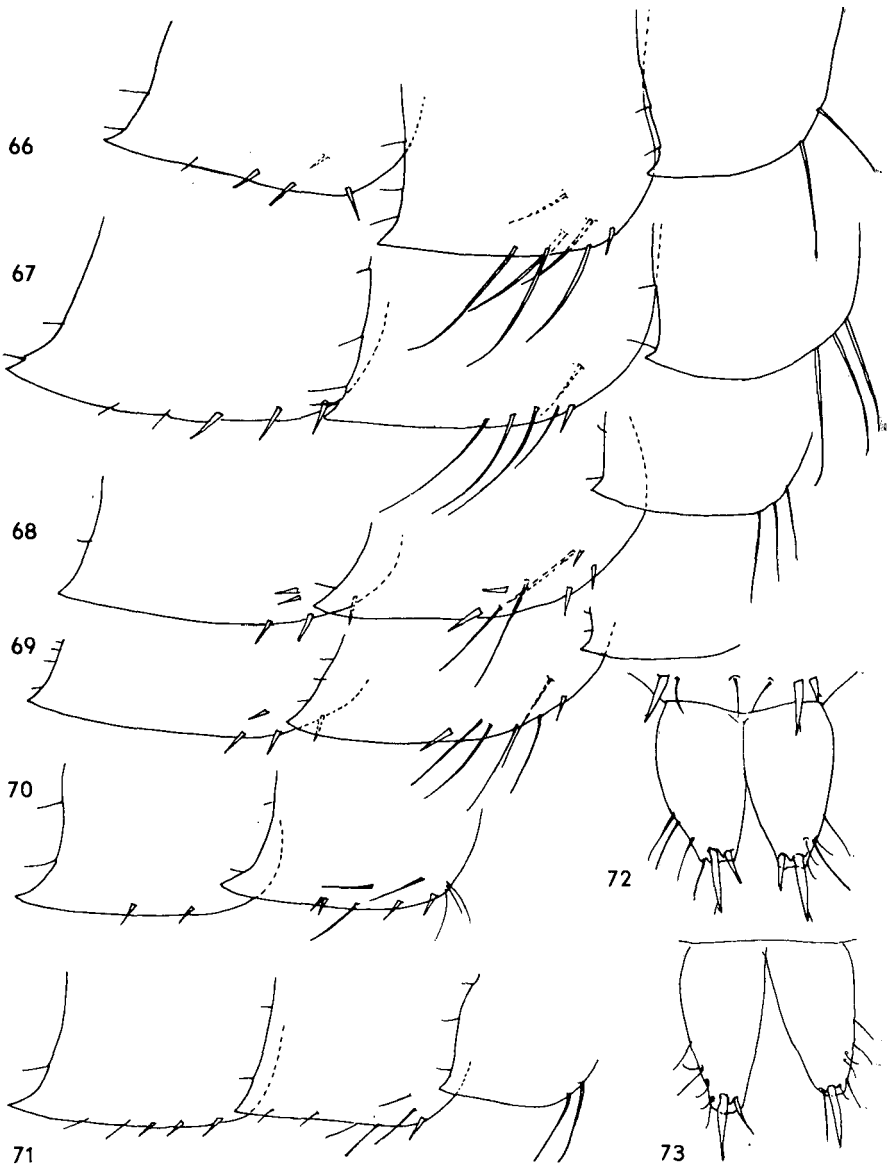
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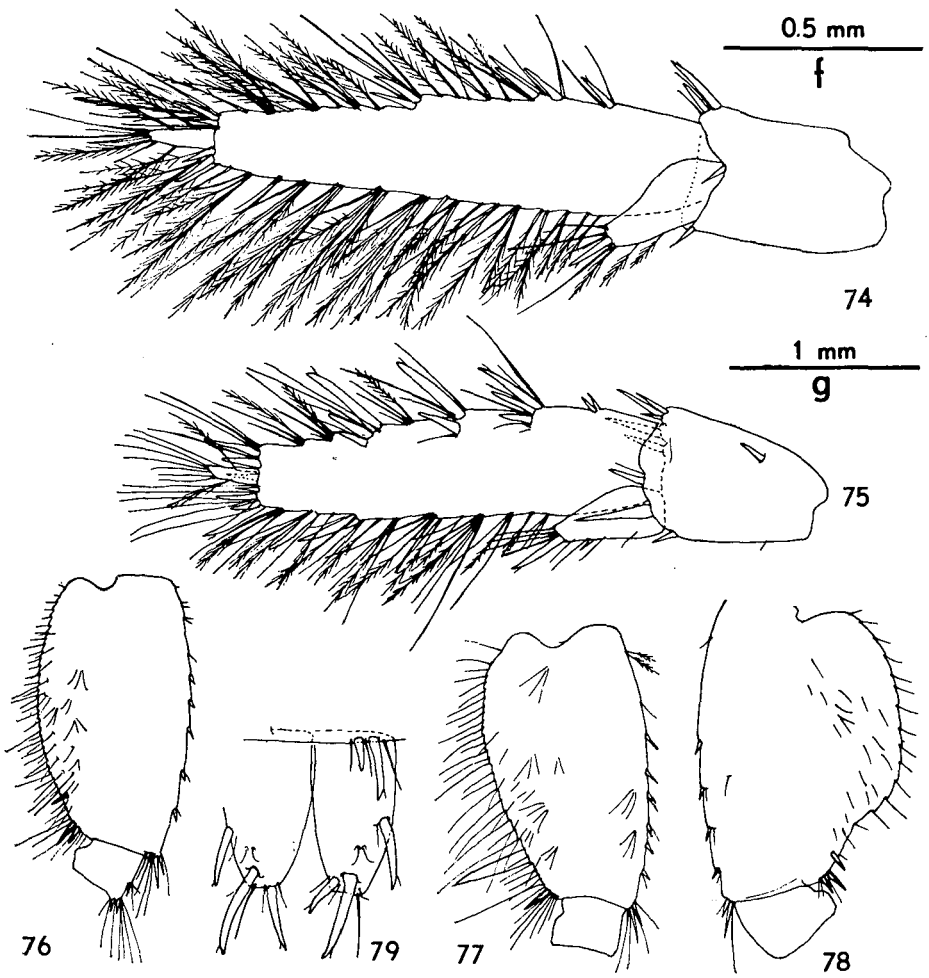
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