GAMMARUS AND *CHAETOGAMMARUS* (CRUSTACEA, AMPHIPODA) FROM MACARONESIA

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With 24 figures

ABSTRACT: Two species of the amphipod family Gammaridae are recorded from Madeira and Tenerife. These species live in the same type of habitat, viz. in cobles near the sea shore with a more of less marked freshwater influence. One species, *Chaetogammarus olivii* (H. Milne Edwards), was already known from Macaronesia, the other is a new species, described as *Gammarus nox* n. sp. The differences between *Chaetogammarus* and some related genera are discussed.

RESUMO: O autor regista a presença de duas espécies de anfípodes gamarídeos para a Madeira e Tenerife. As duas espécies aqui registadas ocorrem no mesmo tipo de habitat, entre as pedras do litoral sob a influência mais ou menos significativa de águas doces. Uma das espécies, *Chaetogammarus olivii* já era conhecida para a Macaronesia enquanto que a outra é nova para a ciência e descrita como *Gammarus nox* n. sp..

São feitas algumas considerações sobre as diferenças entre *Chaetogammarus* e outros géneros próximos.

INTRODUCTION

Several species of gammarids (=family Gammaridae *s. str.*) are known from Macaronesia: *Sarothrogammarus* (one freshwater species on Flores in the Azores, *cf.* CHEVREUX, one freshwater and one poikilohaline species in Madeira, *cf.* STOCK, in press), *Chaetogammarus* (one marine to poikilohaline littoral species in the Azores and Madeira Island, *cf.* DAHL, 1958 and STOCK, 1968), and *Rhipidogammarus* (one species in epigean freshwater streams, one in a cave on Tenerife and another in streams on La Gomera in the Canary Islands, *cf.* STOCK, 1988, STOCK & SANCHEZ, 1990, KARAMAN, 1991, and BEYER & STOCK, 1994). In the present paper a new, poikilohaline species of the nominate genus, *Gammarus*, is described from Madeira and Tenerife, whereas *Chaetogammarus olivii* is recorded from a number of new localities on the same two islands. It is the first time that a member of the genus *Gammarus* is found in non-marine waters of Macaronesia.

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Genus *Gammarus* FABRICIUS, 1775

***Gammarus nox* n. sp.**

Material.

MADEIRA:

1 ♂ Holotype, 1 ovigerous ♀ paratype, 2 ♂ & 3 juvenile paratypes. Stn. 92-50, western end of beach of Ponta do Sol, in springs and little cascades rising from the sea cliff, in gravel, temp. 19.1°C, electric conductivity (eC) at low tide < 0.1µS/cm, but immersed by sea water during periods of high surf, 1 May 1992. Accompanying organisms *Enteromorpha* (Chlorophyta). Zoölogisch Museum Amsterdam (ZMA) Amph 200.333.

2 paratypes.Stn 91-548, same locality as 92-58, but eC 0.8µS/cm, 18 Oct. 1991. ZMA Amph 108.996.

Many paratypes. Stn. 91-545, Machico, discharge of Fonte de São Roque on the beach, in gravel, 20.3°C, eC 4.3µS/cm, 16 Oct. 1991. ZMA Amph. 108.958 and Museu Municipal do Funchal 25.331.

1 ♀ paratype, Stn. 91-549, Ponta do Sol, mouth of Ribeira da Ponta do Sol, in gravel of seaward side of the bar closing off the river mouth, eC 0.5 µS/cm, 18 Oct. 1991. ZMA Amph 108.998.

Many paratypes. Stn 91-543, mouth of Ribeira do Juncal in village Porto da Cruz, under rocks and in gravel, 20.6°C, eC 0.2 µS/cm. 16 Oct. 1991. ZMA Amph. 108.959.

TENERIFE:

Many specimens. Bajamar, in springs rising from the sea cliff, 28 Oct. 1986. ZMA Amph 200.334.

Description. - Male: Body lenght (excluding antennae and uropods) up to 8.8mm. Lateral head lobes (Fig.1) rounded, eye reniform, very large. Pleon unarmed. Urosome segments (Fig. 7) dorsally slightly raised, but not compressed; armature consisting of mid-dorsal and latero-dorsal spines and setae, setae not numerous, slightly longer than spines; usually there are 2 mid-dorsal spines and 2 or 3 latero-dorsal spines on each side of the urosome; on urosomite 1, latero-dorsal spines sometimes absent.

Antenna 1 (Fig. 2): Peduncle segment 1>2, but <2+3; ventral margin of peduncle with several setae longer than segment diameter. Flagellum of 22 segments, with short setules only; aesthetascs shorts (shorter than setae), one on each of segments 3 through 18.

Acessory flagellum 4 segmented, well-developed.

Antenna 2 (Fig. 3) setose (many setae longer than diameter of corresponding segment). Flagellum 12-segmented; one small calceolus on each of segments 1 throught 5. Left mandible with 6-dentate pars incisiva and 5-dentate lacinia mobilis. Right mandible with 5-dentate pars incisiva and complexely built lacinia (Fig. 4). Molar seta present on

right mandible only. Palp (Fig. 5) unarmed basal segment; segment 2 with several setae, subdistial setae long; segment 3 with A-, B-, D-, and E-setae: D-setae numerous (>20) forming regular comb-like row.

Lower lip (Fig. 6) with inner lobes.

Maxilla 1 with 2-segment palp; left palp narrower than right one; left palp with 7 slender distal spines and 2 subdistal setae; right palp with 2 slender distolateral spines and 5 robust, triangular, tooth-like distal spines. Outer lobe with 11 spines, from lateral to median these spines bear 1-2-5-3-5-5-6-6-6-6-7 medial denticles, respectively. Inner lobe elongate-triangular, medial margin with ca. 13 plumose setae.

Maxilla 2 and maxilliped "normal" (see for instance KARAMAN in RUFFO, 1982, fig. 202).

Gnathopod 1 (Fig. 10): Ventral margin of coxal plate without setae. Carpus trapezoidal, not elongated. Propodus ovate, palma very oblique; robust and 2 small palmar angle spines; 1 mid-palmar spine; palmar margin slightly concave (Fig. 11).

Gnathopod 2 (Fig. 16): Ventral margin of coxal plate without long setae. Carpus as in gnathopod 1. Propodus sub-rectangular, slightly larger than that of gnathopod 1; 3 strong palmar angles spines; 1 mid-palmar spine; palmar margin concave, not very oblique (Fig. 17).

Pereiopod 3 (Fig. 20): Coxal plate ventrally unarmed, rectangular. Posterior margin of merus with 8 groups of long, glabrous setae (several setae longer than diameter of segment). Posterior margin of carpus with 4 groups of long, glabrous setae, and 1 or 2 spines in each group. Propodus with 5 spines and a few short *setae*. Unguis curved.

Pereiopod 4 (Fig. 21): Coxal plate wider than long, with deep posterior emargination. Merus and carpus shorter than in pereiopod 3; setae less numerous and shorter.

Pereiopod 5 (Fig. 22): Posterior margin of basis with 8 to 10 very short setules posteroventral angle strongly produced, unarmed. Distal segments spiniferous, the few setae present are shorter than the spines. Claw curved.

Pereiopod 6 (Fig. 23) longer than pereiopod 5. Posterior margin of basis almost straight, with ca. 8 very short setules; posteroventral angle not produced but armed with 2 spines. Setae on merus and carpus scarce and short. Claw curved.

Pereiopod 7 (Fig. 24) longer than pereiopod 6. Posterior margin of basis slightly convex with ca. 8 very short setules. Posteroventral. Posteroventral angle of basis and distal segments as in pereiopod 6.

Coxal gills (Fig. 16, 22) stalked, globular, on gnathopod 2 and pereiopods 3 through 6; small and ovate on pereiopod 7 (Fig. 24).

Epimeral plate 1 without ventral armature; ventroposterior angle rounded, with minute tooth. Epimeral plates 2 and 3 with slightly pointed ventroposterior angle; ventral margin with 1 spine (plate 2) or 1 seta and 1 spine (plate 3). Posterior margin of all plates with 1 or

2 setules (Fig. 8).

Uropod 1 (Fig. 13) overreaching tip of uropod 2; small proximoventral peduncular spine present. Both rami with 1, 2 or 3 dorsal spines and 5 terminal spines.

Uropod 2 (Fig. 14): Rami with 1 or 2 centro-dorsal spines and 5 terminal spines.

Uropod 3 (Fig. 15) rather short. Exopodite robust; outer and inner margins of segment 1 with numerous long, plumose setae (plumosity omitted in figure); outer margin moreover with several short spines, segment 2 minute, slightly longer than wide, shorter than terminal spines of segment 1 and hidden between distal setae of segment 1. Endopodite linear, of variiramous type, lenght 35-40% of length of exopodite segment 1; armature consisting of several (ca.8) long. plumose medial setae and 1 terminal spine.

Telson (Fig. 9) completely cleft; each lobe with 3 lateral spines (sometimes accompanied by a seta which is a long as the spines) and 3 or 4 distal spines, accompanied by 2 to 4 setae, of which the longest are much longer than the spines; two sensorial setules implanted on dorsal surface, halfway between lateral and distal spines.

Female: Low number of eggs (up to 3 eggs per female). Smaller than male. Antenna 2 without calceoli. Propodus of gnathopods smaller than in male. Propodus of gnathopod 1 (Fig. 12) trapezoidal; palma not oblique, palmar margin slightly convex; 4 palmar angle spines, no mid-palmar spine. Propodus of gnathopod 2 (Fig.18) rectangular; palmar margin slightly concave; no mid-palmar spine; 2 robust and slender, bifid palmar angle spines. Oostegites narrow (Fig.19).

Live colour: Brown, grey-brown or grey-green, rarely more pale. Eye black.

Etymology: In classical mythology, Nox or Nyx was the goddess of the night, whose palace stood at the entrance of underworld. The *Gammarus* species described above lives in small springs rising from the sea cliff, or in the resurgence of stream water through gravel bars, thus figuratively speaking at the entrance of the underworld.

Remarks: The variiramous third uropod of the new species indicates that it belongs to *Gammarus* and not to *Chaetogammarus* (see also LINCOLN, 1979). By the relative length of the inner ramus of uropod 3 (inner ramus distinctly less than half as long as segment 1 of outer ramus), the new species approaches *Gammarus finmarchicus* DAHL, 1938 (=*G. greenfielddi* SHOEMAKER, 1938), from the North Atlantic, but *G. nox* differs markedly in the morphology of the basis of pereiopod 7 (freely produced, without spines, in *finmarchicus*, not produced, with spines, in *nox*). Moreover the eye of *G. nox* is much larger; uropod 3 of *G. nox* possesses an, admittedly small, 2nd exopodite segment (absent in *finmarchicus*); the 4th and 5th peduncle segments of antenna 2 are less slender in *G. nox*; the 2nd male antenna bears calceoli in *G. nox* (absent in *finmarchicus)*; etc.

On first sight *G. nox* might be confused with *Chaetogammarus olivii*, with it shares large eyes, non-setiferous coxal and epimeral plates, and short setules on the basis of pereiopod 5 to 7, and which lives in the same sort of habitat. On closer inspection, however, several differences become apparent, e.g. the longer endopodite of uropod 3 (variiamous in *G. nox*, parviramous in *Ch. olivii*), the very much shorter 2nd exopodite segment of uropod 3 in G. nox, the presence of longer setae on merus and carpus of pereiopods 3 to 7, the presence setae on the dorsal surface of the urosome and the presence of calceoli on antenna 2 of the male.

Chaetogammarus dahli STOCK, 1968 agrees with *G. nox* in the presence of calceoli on the male second antenna, but differs otherwise in the same way as does *C. olivii* from *G. nox*. Moreover, the peduncular segments of antenna 1 and the merus and carpus of the posterior pereiopods of. *C. dahli* are much shorter.

Genus *Chaetogammarus* MARTYNOV, 1925

The status of this genus has lately been discussed (see, for instance, KARAMAN, 1977a, b). In an earlier paper (STOCK, 1968) I made an attempt to locate the species with setiferous coxal and epimeral plates, and with long setae on legs and urosome in *Echinogammarus* and the poorly setose species in *Chaetogammarus*. I have to admit now that this attempt failed, since several taxa are intermediate between such two groups. However, a computer run, using PHYLIP and PAUP, of some 40 species of both "genera", revealed a definite break into a two groups:

(1) *Echinogammarus* should be used used for a relatively small group of species centred around the type-species of the genus, *E. berilloni* (see PINKSTER, 1973, for most species of this group). A stritkly monophyletic group arises, morphologically characterized by a strong dorsal and lateral spinosity and setosity of the pleon and very slender and elongate peduncle segments of antennae 1 and 2. This group has its centre of origin in the mountainous regions of the Iberian peninsula, from where it radiated or dispersed to adjacent parts of western Europe, probably as late as in the Pleistocene or Holocene.

This group consists of freshwater taxa with a limited tolerance to increased salinities.

(2) *Chaetogammarus* (type-species *C. ischnus*) has an unarmed pleon and less slender antennae. Its centre of origin lies along the borders of the European Tethys Sea, in interdital, lagoonal, estuarine, or otherwise poikilohaline waters, from where its members radiated under the influence of various marine regressions and transgressions during the Neogene. It occurs nowadays in several geographic isolates in springs and rivers of areas that were once inundated by sea-water. In this group reside all species previously placed in *Marinogammarus* and *Chaetogammarus*, and most species usually called *Echinogammarus*, but for species cluster around the type species of that genus, *E. berilloni*.

The computer run does not provide unanimity about two small species groups, viz. the *simoni*-group (Ibero-African), and the *pacaudi*-group (Aquitanian). A more detailed analysis of these taxa will be necessary to elucidate their true relationships.

At any rate, I retained *Chaetogammarus* in this paper as a good - and as presently defined - large genus, of which one species only is known from Madeira.

Chaetogammarus olivii (H. MILNE EDWARDS, 1830)

Chaetogammarus olivii, STOCK, 1968: 66-71, figs. 31-33 (re-examination of type specimens; principal refs. and synonymy).

Marinogammarus atlanticus, DAHL, 1958: 11-15, figs. 2-4.

Echinogammarus olivii, KARAMAN in RUFFO, 1982: 175, fig. 185.

Material.

MADEIRA:

Stn. 91-509, mouth of Ribeira Brava, in gravel, eC 1.3 µS/cm, 10 Oct. 1991. ZMA Amph. 108.960.

TENERIFE:

Stns. 71-2 and 71-3, Las Águas (= 14 km W of Puerto de la Cruz), shingle beach, 28 Mar. 1971. ZMA. 102.893 to 102.895.

Stn. 71-5, Los Frailes, 2 km W of Puerto de la Cruz, in gravel of rock pools, 23 Mar. 1971. ZMA Amph. 102.897.

Stn. 71-6, Punta del Hidalgo, in gravel of mouth of torrente, 24 Mar. 1971. ZMA Amph. 102.896.

Stn. 71-7, Puerto de la Cruz, interdital zone, 27 Mar. 1971. ZMA Amph. 102.892.

Stn. 88-503, Fuente del Palamo on the beach of Jóver, eC 9.12 µS/cm, 26 Oct. 1988. ZMA Amph. 200.320.

No station number, San Marcos (= W. of Icod), in gravel at foot of cliff, with influence of fresh water dripping from the rocks, 2 Nov. 1986. ZMA Amph. 200.321.

Remarks. - DAHL records this species, under the name of *Marinogammarus atlanticus*, from São Miguel and Santa Maria (Azores), and from Funchal (Madeira). This species inhabits almost the same type of habitat as *Gammmarus nox*, viz. cobble beaches with (temporary) influences of fresh waters, but *Ch. olivii* prefers places which are inundated by sea water daily at high tide, whereas the habitat of *G. nox* receives marine influences only during periods of heavy surf.

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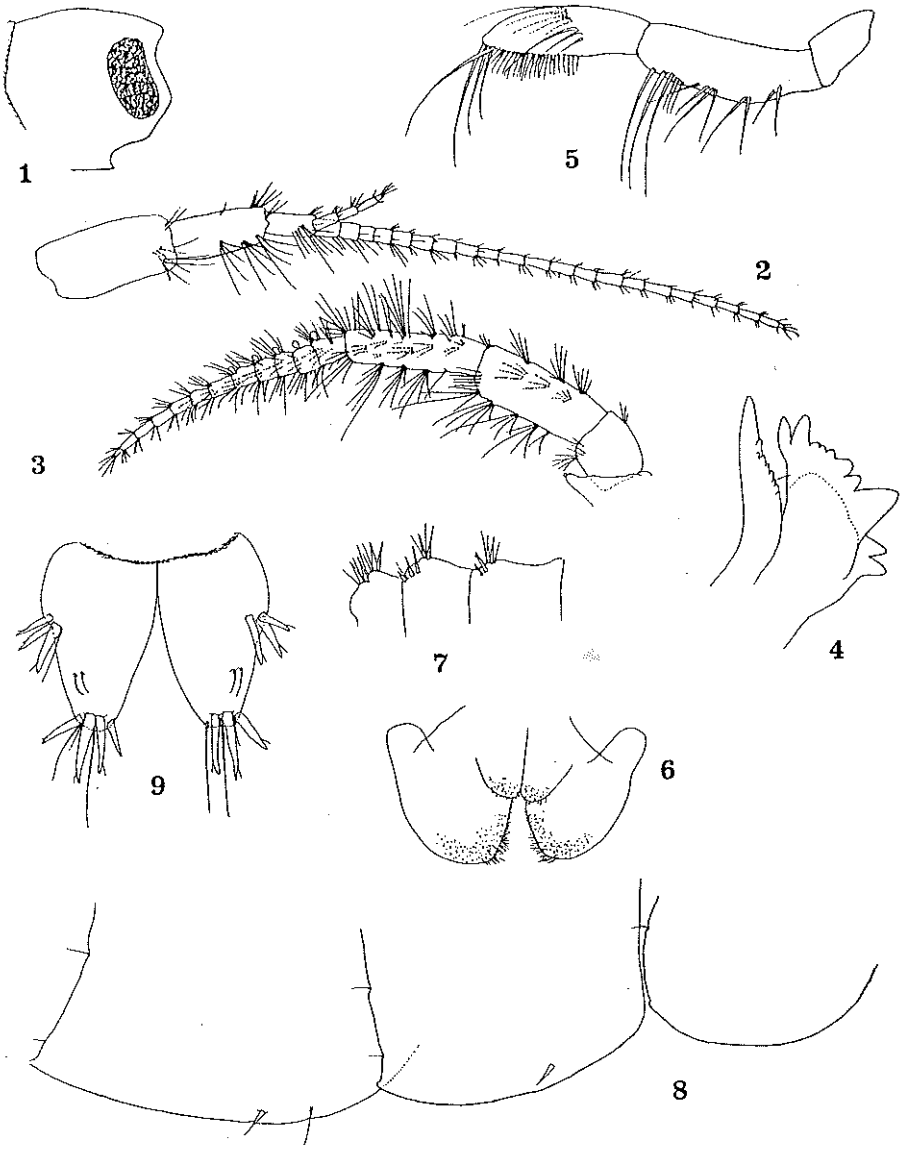
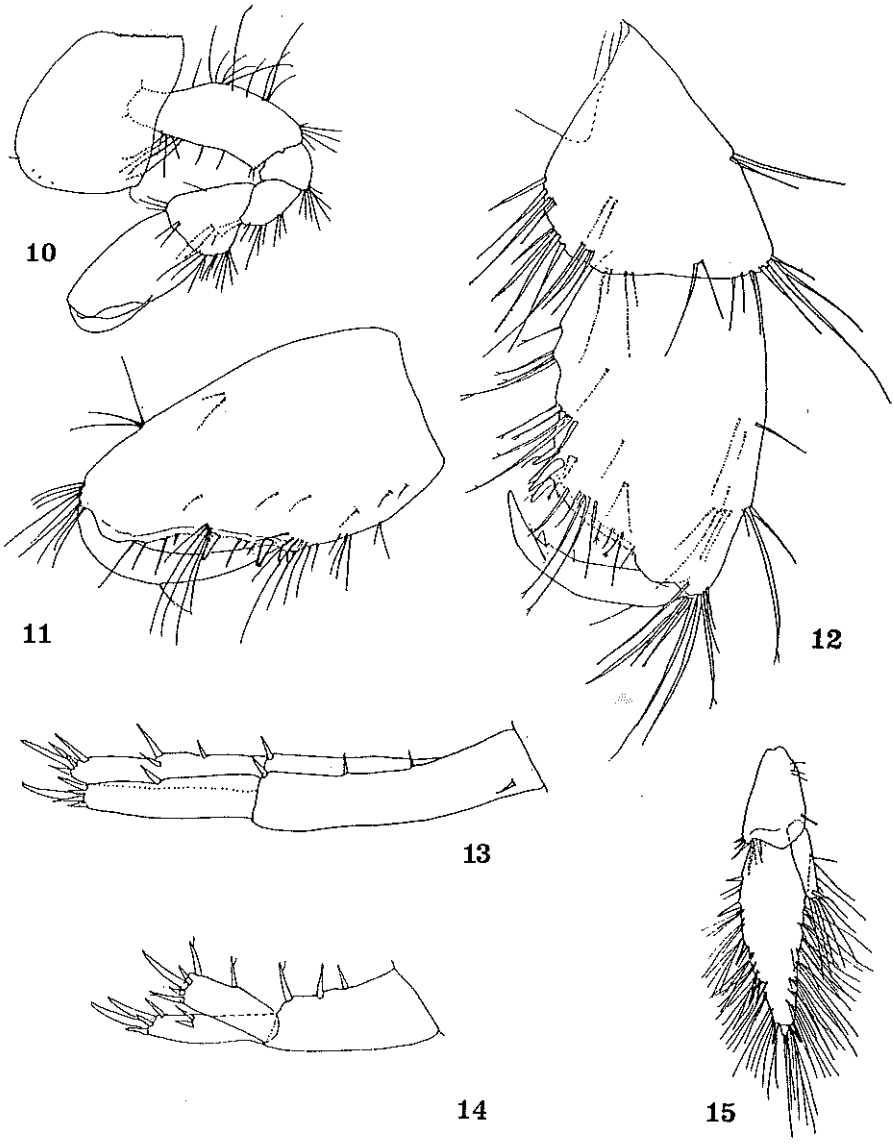
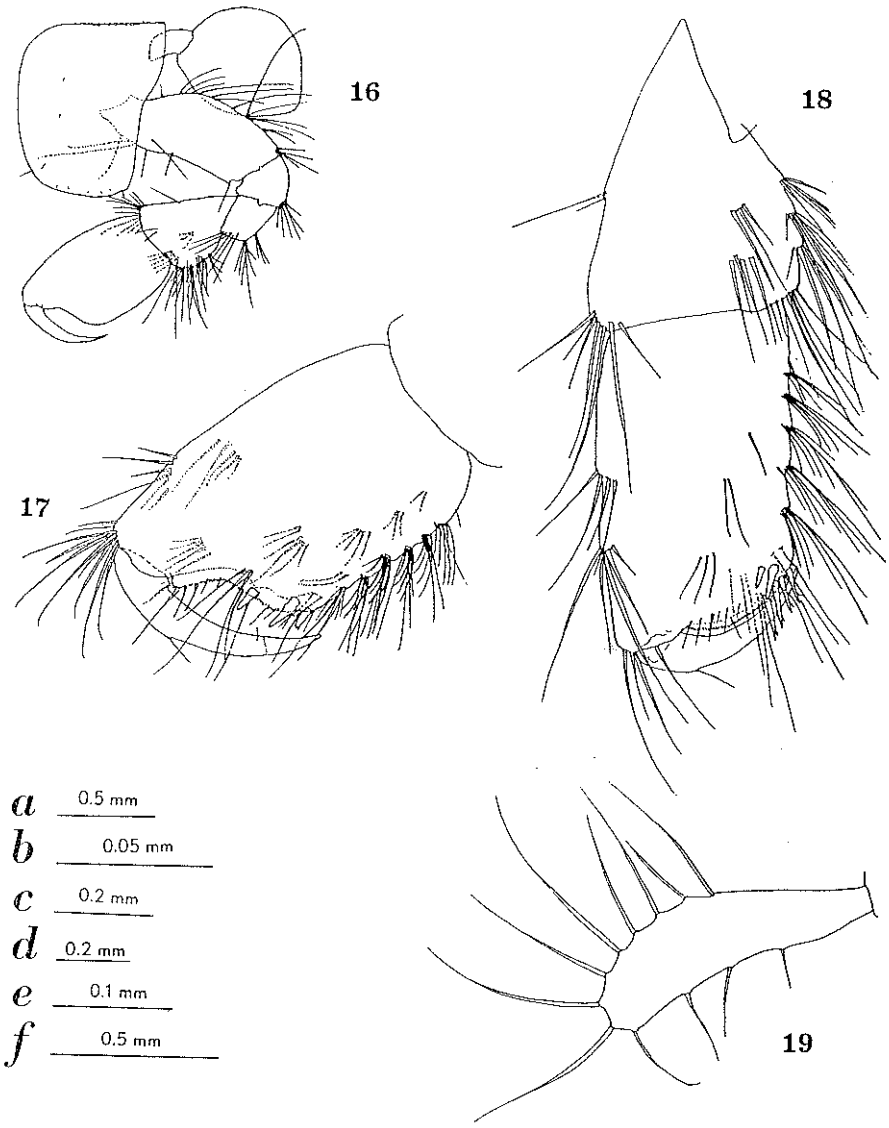


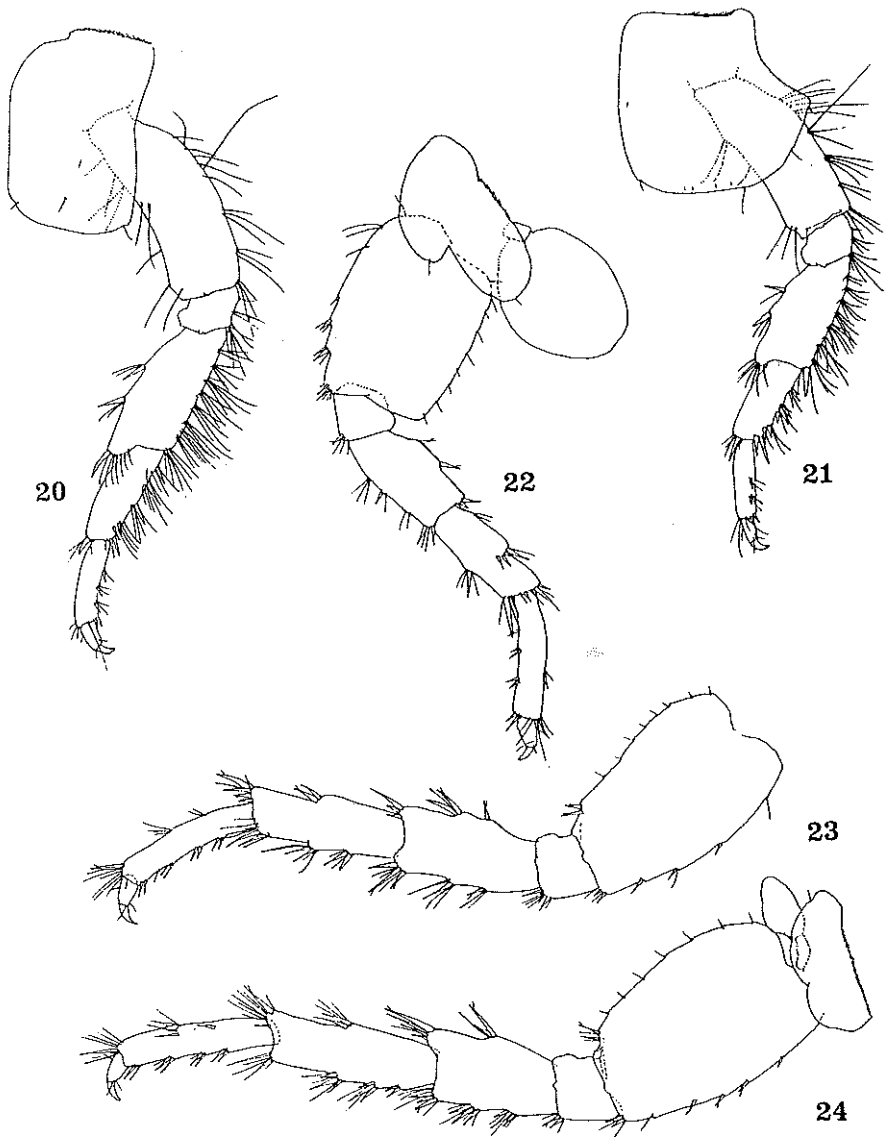
Figs. 1-9. *Gammarus nox* n. sp., ♂ holotype: 1 - head, from the right; 2 - antenna 1 (scale a); 3 - antenna 2 (a); 4 - right lacinia mobilis (b); 5 - mandible palp (c); 6 - lower lip (c); 7 - ursomites 1 to 3, from the right (a); 8 - epimeral plates 1 to 3, from the right (a); 9 - telson (c). Scales below fig. 17.



Figs. 10-15. *Gammarus nox* n. sp., ♂ holotype and ♀ allotype: 10 - gnathopod 1, ♂ (scale a); 11 - propodus of gnathopod 1, ♂ (c); 12 - carpus and propodus of gnathopod 1, ♀ (e); 13 - uropod 1, ♂ (f); 14 - uropod 2, ♂ (f); 15 - uropod 3, ♂, all setae are plumose, but plumosity omitted in figure (a) Scales below fig. 17.



Figs. 16-19. *Gammarus nox* n. sp., ♂ holotype and ♀ allotype: 16 - gnathopod 2, ♂ (scale a); 17 - propodus of gnathopod 2, ♂ (c); 18 - carpus and propodus of gnathopod 2, ♀ (e); 19 - oostegite of gnathopod 2, ♀ (2).



Figs. 20-24. *Gammarus nox* n. sp., ♂ holotype: 20 - pereiopod 3; 21 - pereiopod 4; 22 - pereiopod 5; 23 - pereiopod 6; 24 - pereiopod 7. All to scale a. Scale below fig. 17.

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