

THE GENUS *SAROTHROGAMMARUS* MARTYNOV, 1935 (CRUSTACEA, AMPHIPODA) IN MADEIRA

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With 28 figures

ABSTRACT: A second record of *Sarothrogammarus madeirensis* (DAHL, 1958) is reported, and its poikilohaline and subterranean habitat is confirmed. From a Madeiran freshwater stream, a new species of *Sarothrogammarus* is described, *S. cataractae* n. sp. The generic status of these species is discussed and *Lusigammarus* BARNARD & BARNARD, 1983 is reduced to a synonym of *Sarothrogammarus*.

Key words - *Sarothrogammarus madeirensis*, *S. cataractae* n. sp., *Lusigammarus*, Madeira.

RESUMO: O autor regista pela segunda vez a existência de *Sarothrogammarus madeirensis* (DAHL, 1958) e confirma as características poiquilohalinas e subterrâneas do seu habitat. É descrita uma nova espécie de *Sarothrogammarus*, *S. cataractae* n. sp. . Da discussão do status genérico desta espécie resulta a passagem de *Lusigammarus* BARNARD & BARNARD, 1983 o sinónimo de *Sarothrogammarus*.

INTRODUCTION

During a study of groundwater organisms in Madeira we came across a rare species of gammarid amphipod, *Sarothrogammarus madeirensis*, which after its discovery by DAHL (1958) was never collected again. It lives on the north coast of the island, in habitats with enormous daily fluctuations in salinity. Still more surprising was the discovery of a second Madeiran species of *Sarothrogammarus* in a freshwater cascade on the south coast which is described in the following pages as *S. cataractae*.

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Sarthrogammarus madeirensis (DAHL, 1958)

Figs. 1-2

Gammarus (*Sarthrogammarus*) *madeirensis* DAHL, 1958: 18-20, fig. 5.

Sarthrogammarus madeirensis; STOCK, 1971: 109-110, Figs. 1 i-j, 11-13 (redescription of type material; older literature).

Echinogammarus madeirensis; KARAMAN & RUFFO, 1977: 179 (text); KARAMAN, 1977a: 79 (text).

Neogammarus madeirensis; KARAMAN, 1971: 206 (text); KARAMAN, 1977a: 75 (text); KARAMAN, 1977b: 110, 114, 116 (text).

Lusigammarus madeirensis; BARNARD & BARNARD, 1983: 497 (listed).

Material -> 80 adults (including ovigerous females) and many juveniles presumably of the same species. Madeira, Stn. 92-45. Mouth of Ribeira de São Jorge, E. of village of S. Jorge, UTM coordinates CB³2274 x³⁶3368. 30 Apr. 192. At low tide the river water percolates through a gravel bar, closing off the river mouth. The animals have been collected at the seaward slope of the bar, with the aid of a Bou-Rouch biophreatic pump at a sediment depth of 60-80 cm under the surface of the shingles. At low tide the water is fresh (electric conductivity 0.1 μ S/cm) at a temperature of 20°C. At high tide this habitat is covered by seawater. Accompanying fauna: *Jaera* sp. (Isopoda). Material preserved in the Zoölogisch Museum Amsterdam, ZMA Amph. 200.224 and the Museu Municipal do Funchal, MMF 25345.

1 ♀ (ovig.), 6 juveniles. Madeira, Stn. 92-46. Almost same place as 92-45 (vide supra), UTM coordinates CB³2276 x³⁶3366, but in coarse black (volcanic) sand, 40 cm under the sediment surface, within the reach of the waves. 30 Apr. 1992. Electric conductivity at low tide 0.4 μ S/cm at a temperature of 17.2°C; at high tide fully marine. Accompanying fauna: *Jaera* sp. (Isopoda). ZMA Amph. 200.225.

The species has not been encountered at the landward side of the gravel bar, where the salinity fluctuations are less abrupt.

Remarks. - This species has been adequately described by DAHL (1958), and redescribed by STOCK (1971) on the basis of DAHL's type-material. Some new illustrations (Figs. 1-2) are provided in the present paper, just to demonstrate some salient differences between *S. madeirensis* and the new species, *S. cataractae*.

Despite numerous citations in the literature, no further material became known, apart from DAHL's original specimens, which were collected in the mouth of the Ribeira do Faial, among boulders in an around small pools on the bar in the estuary of the stream. These pools were usually filled with fresh water, but were flooded by seawater during gales. It is a typically poikilohaline form (DAHL, 1959:233), and not an animal from "springs and brooks"

as erroneously stated by BARNARD & BARNARD (1983).

The present material thus represents only the second record for this species and confirms its poikilohaline habitat. Numerous attempts, in 1991 and 1992, to rediscover *S. madeirensis* at its type-locality, the mouth of the Ribeira do Faial, failed, perhaps due to the fact that river bed is nowadays very disturbed by gravel exploitation and quarrying.

Both localities from which *S. madeirensis* is known, Faial and S. Jorge, are situated on the strongly exposed north coast of Madeira.

The ovigerous females carry a low number (1 to 5) of large eggs. Moreover, the eyes of juveniles are very poorly pigmented, usually only 3 to 5 ocelli bearing a reddish pigment, although the adults have small, but well-pigmented eyes. Our specimens were collected from 40 to 80 cm deep in the sediment. These observations confirm DAHL's supposition that this amphipod leads a "semi-subterranean" life.

Generic status of *S. madeirensis*.- This species drifted from one genus to another over the past 35 years (*Gammarus*, *Sarothrogammarus*, *Echinogammarus*, *Neogammarus*, *Lusigammarus*). In my revision of the *Sarothrogammarus* group of genera (STOCK, 1971), I thought the best fit was *Sarothrogammarus*, an opinion that I still hold. It cannot be classified with *Neogammarus*, because the members of this genus have miniaturized first uropods, which *S. madeirensis* has not. *Echinogammarus* lacks a modified (so called filtrative) third pereopod in the male, which is present in *S. madeirensis*, and *Lusigammarus* is based on non-existing features (see below under *S. cataractae*). The remarkable distribution of the members of *Sarothrogammarus*, from Afghanistan and Turkestan, through Sicily, to the Azores and Madeira, corresponds roughly with a Tethyan/Sarmatian pattern shown by many other aquatic animals, e.g. by the closely related genus *Rhipidogammarus*, which is known from the Mediterranean belt and certain islands of the Canary archipelago (La Gomera and Tenerife). Noteworthy also is that the members of *Rhipidogammarus* show the same range in habitats: from gravel bars in estuaries with strongly fluctuating salinities to subterranean and epigeal freshwater streams.

Sarothrogammarus cataractae n. sp.

Figs. 3-28

Material.- 1 ♂ (holotype), 1 ♀ ovig. (allotype, dissected), 9 paratypes (1 ♂ dissected). Madeira Stns. 92-52 and 92-54. In a small cascade along the north side of the road from Ponta do Sol to Madalena do Mar, in hamlet Anjos (450 m E. of the traffic tunnel of Anjos). UTM coordinates CB 73021x 361823. The cascade discharges into a small basin. Altitude ca. 100 m a.s.l. Electric conductivity 0.4 μ S/cm, temperature 16.9°C. 2 and 3 May 1992. Accompanying organisms: rich growth of diatoms, insect larvae, hydrobiid snails. The type-material has been preserved in the Zoölogisch Museum Amsterdam, cat. nr. ZMA

Amph 200.226.

Description. - Body length of adult male and ovigerous female (2 eggs) 4.5 mm.

Live specimens pale straw-coloured. Eyes well-pigmented, slightly ovate (Fig. 3). Lateral head lobes truncate (Fig. 3). Each side of urosomites 1 and 2 with 1 + 2 spines, of urosomite 3 with 1 spine (Fig. 5).

Male: Antenna 1 (Fig. 6): 4, 5, and 3 groups of long, partly bifid, setae on ventral margin of peduncle segments 1 to 3, respectively. Accessory flagellum well-developed, 4-segmented. Flagellum 20-segmented, with long setae; club-shaped aesthetascs short (25% of length of corresponding flagellum segment), one on each of flagellum segments 4 to 18.

Antenna 2 (Fig. 7): shorter than antenna 1. Peduncle segments 4 and 5 with 5 and 4 groups of long, partly bifid, setae on ventral margin. Gland cone short, rounded conical. Flagellum 9-segmented, without calceoli or aesthetascs.

Upper lip egg shaped, normal. Lower lip (Fig. 9) without inner lobes. Mandible palp (Fig. 8) 3-segmented, strong; segment 1 naked; segment 2 with many long ventral and subventral setae; segment 3 with full setal ornamentation (A-, B-, C-, D-, and E-setae present), D-setae of irregular lengths. Right lacinia mobilis bifid, one fork with 5, other fork with 4 small teeth; left lacinia 4-dentate. Maxilla 1: right palp widened, segment 2 with 4 triangular teeth, 1 latero-subdistal seta, and 1 latero-subdistal spine; left palp narrower, segment 2 with 7 spines and 2 setae.

Gnathopod 1 (Fig. 10): Coxal plate distally wider than proximally. Carpus trapezoidal, with 3 posterior and 1 posterodistal groups of setae. Propodus (Fig. 11) elongate-ovate, with short concave palmar margin; 3 palmar angles spines + 1 spine on medial surface (displaced mid-palmar spine?).

Gnathopod 2 (Fig. 16): Coxal plate rounded rectangular. Carpus elongate-triangular. Propodus of about same size as that of gnathopod 1 (Fig. 17), rectangular; palmar margin short, concave; palmar angle with group of 4 spines (one of which medial).

Pereiopod 3 (Fig. 22) modified, i.e. merus and carpus widened, with transverse rows of long, plumose setae; similar setae also present on propodus.

Pereiopod 4 (Fig. 23) unmodified. Coxal plate with distinct posterior excavation.

Pereiopod 5 (Fig. 24): Coxal plate anterolobate. Basis less than 1.5 times as long as wide, with convex anterior, and straight posterior margin; latter with about 9 serrations; medial surface of basis with 1 subdistal spine.

Pereiopod 6 (Fig. 25): Coxal plate anterolobate. Basis 1.5 time as long as wide, with convex anterior and weakly concave posterior margin; latter with about 9 serrations; medial surface with 2 spines.

Pereiopod 7 (Fig. 26): Coxal plate non-lobate. Basis 1.7-1.8 times as long as wide, with convex anterior and almost straight posterior margin; latter with about 7 serrations; medial surface with 3 spines.

Coxal gills ovate, stalked, on gnathopod 2 and pereopods 3 through 6.

Pleopods biramous, ordinary. Epimeral plates (Fig. 4) with slightly pointed posteroventral angle; ventral margin of plates 1 and 2 naked, of plate 3 with 2 spines; posterior margin with 1 or 2 setules.

Uropod 1 (Fig. 13) reaching to tip of uropod 2 (Fig. 5) Peduncle with proximoventral spine; outer and inner dorsal margins spinous. Exopodite with 1 dorsal spine (sometimes lacking) and 5 distal spines; endopodite with 1 dorsal spine (always present) and 5 distal spines.

Uropod 2 (Fig. 14) rather feebly armed; no spines on dorsal margin of rami.

Uropod 3 (Fig. 20) parviramous; endopodite scale-like, with 1 distal setule; exopodite segment 1 with 4 to 5 groups of strong spines on medial and lateral margins; segment 2 narrow, small but distinct, distally armed with 2 minute setules.

Telson (Fig. 15) completely cleft; lobes shortish, ovate, lateral margin with 1 subbasal spine; distal margin with 2 shorter and 1 longer spine; 2 sensorial setae implanted between subbasal and distal spines.

Female.- Morphology similar to that of male, except for following appendages:

Gnathopod 1 (Fig. 12): Propodus smaller; palmar margin regularly convex; 3 palmar angle spines.

Gnathopod 2 (Fig. 18) Propodus of small size, as large as that of gnathopod 1; palmar margin convex; 3 palmar angle spines.

Pereopod 3 (Fig. 21): Merus and carpus not widened, with fewer and shorter plumose setae than in male (setae on merus almost as long as diameter of segment). Propodus without long setae. In younger specimens, setal fan on merus and carpus less distinctly developed.

Basis of pereopod 7 (Fig. 27) fundamentally as in male, slightly less elongate; 2 or 3 spines on medial surface.

Uropod 3 (Fig. 19): Exopodite slightly less elongate than in male.

Oostegites (Fig. 28) linear to club-shaped, setose; present on gnathopod 2 and pereopods 3 through 5.

Etymology.- The specific name, *cataractae*, is the genitive of the Latin word *cataracta*, meaning cascade, alluding to the habitat of the taxon.

Remarks.- The new species, from a Madeiran freshwater stream with cascades, is phenetically similar to the poikilohaline *S. madeirensis* (DAHL, 1958), likewise from Madeira, and to *S. guernei* (CHEVREUX, 1889) from freshwater streams on the island of Flores in the Azores.

In contradistinction to *S. madeirensis*, which lives in a habitat with strong (daily) fluctuations in salinity, *S. cataractae* n. sp. was found some 100 m above the sea-level, in

completely and permanently fresh water, far outside the range of tides and gales.

The morphological differences between the three related species are as follows:

In *S. guernei* the propodus of gnathopods 1 and 2 (♀) is wider, and the palmar margin is longer; the palm of these gnathopods (♂) is less excavate; palmar angle spines are more numerous. The third segment of the mandible palp of *S. guernei* is shorter and stouter. The telson of *S. guernei* bears more spines and the lobes are wider. The posterior margin of the basis of pereopods 5 to 7 of *S. guernei* is less distinctly serrate.

The main difference from *S. madeirensis* resides in the quite different shape of the basis of pereopods 5 to 7 (very elongate, in 7th leg 2.25 times as long as wide, with concave posterior margin in *S. madeirensis*; against much less than twice as long as wide, with straight posterior margin, in *S. cataractae*; compare Fig. 2 with Figs. 24-27). The merus and carpus of pereopod 3 (♀) of *S. madeirensis* bear short, glabrous setae only, instead of the long, plumose setae found in *S. cataractae* (compare Fig. 1 with Fig. 21). The posterior margin of the basis of pereopods 5 to 7 is, just as in *S. guernei*, less clearly serrate than in *S. cataractae*. The basis of pereopod 5 of *S. madeirensis* is devoid of a spine on the medial surface.

Remarks on the genera *Sarothrogammarus* and *Lusigammarus*. - The genus *Sarothrogammarus* was created by MARTYNOV (1935) for a freshwater gammarid, *S. asiaticus*, collected in cold streams and torrents in the Hissar range (S. Turkestan) at altitudes of 2650-2750 m. In 1983, BARNARD & BARNARD splitted the genus into 3 generic units, *Sarothrogammarus* s. str., *Lusigammarus*, and *Tadzhikistania*. I agree with BARNARD & BARNARD as to the validity of the latter genus, but I am unable to accept the separation of *Sarothrogammarus* and *Lusigammarus*. The latter genus, in BARNARD & BARNARD's conception, comprises 3 species: *L. guernei* (CHEVREUX, 1889) from streams on Flores, Azores; *L. madeirensis* (DAHL, 1958) from poikilohaline pools in an estuary on Madeira; and *L. catacumbae* (KARAMAN & RUFFO, 1977) from a spring in the catacombs of S. Lucia (Sicily), altitude 650 m a.s.l.

The genus *Lusigammarus* (abbreviated *L.*) is characterized against *Sarothrogammarus* (abbreviated *S.*) by the following features (BARNARD & BARNARD, 1983: Key on p.493, and text on p. 496): (1) palm of male gnathopod 2 concave in *L.* and straight in *S.*, without mid-palmar spine in *L.* and with mid-palmar spine in *S.*; (2) telson without apical setae in *L.*, with setae + spines in *S.*

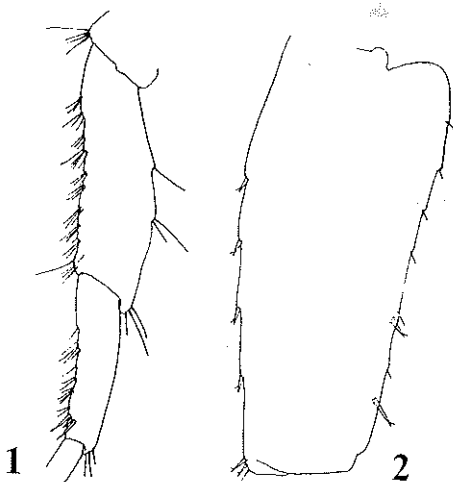
Of the three species attributed to *L.*, two (*guernei* and *madeirensis*) have a concave palm of the male 2nd gnathopod, but the third (*catacumbae*) has a straight palm. The mid-palmar spine, supposed to characterize *Sarothrogammarus*, is absent in the type species of the genus, *S. asiaticus* (see MARTYNOV, 1935, Fig. 58 b) as well as in *S. afghanus* (RUFFO, 1958) (see RUFFO, 1958, Fig. IV-4), *S. lindbergi* KARAMAN, 1969 (see KARAMAN, 1969, Fig. 6) and *S. multipennatus* KARAMAN, 1969 (KARAMAN, 1969: 205: "I-II Gnathopoden ähnlich wie bei *lindbergi*"), although these species were all classified with *S.* and not with *L.*

by the BARNARDS. The same holds true for the telsonic setae; although *S.* allegedly possessés telsonic setae, the type species, *S. asiaticus*, is devoid of setae (MARTYNOV, 1935, Fig. 61).

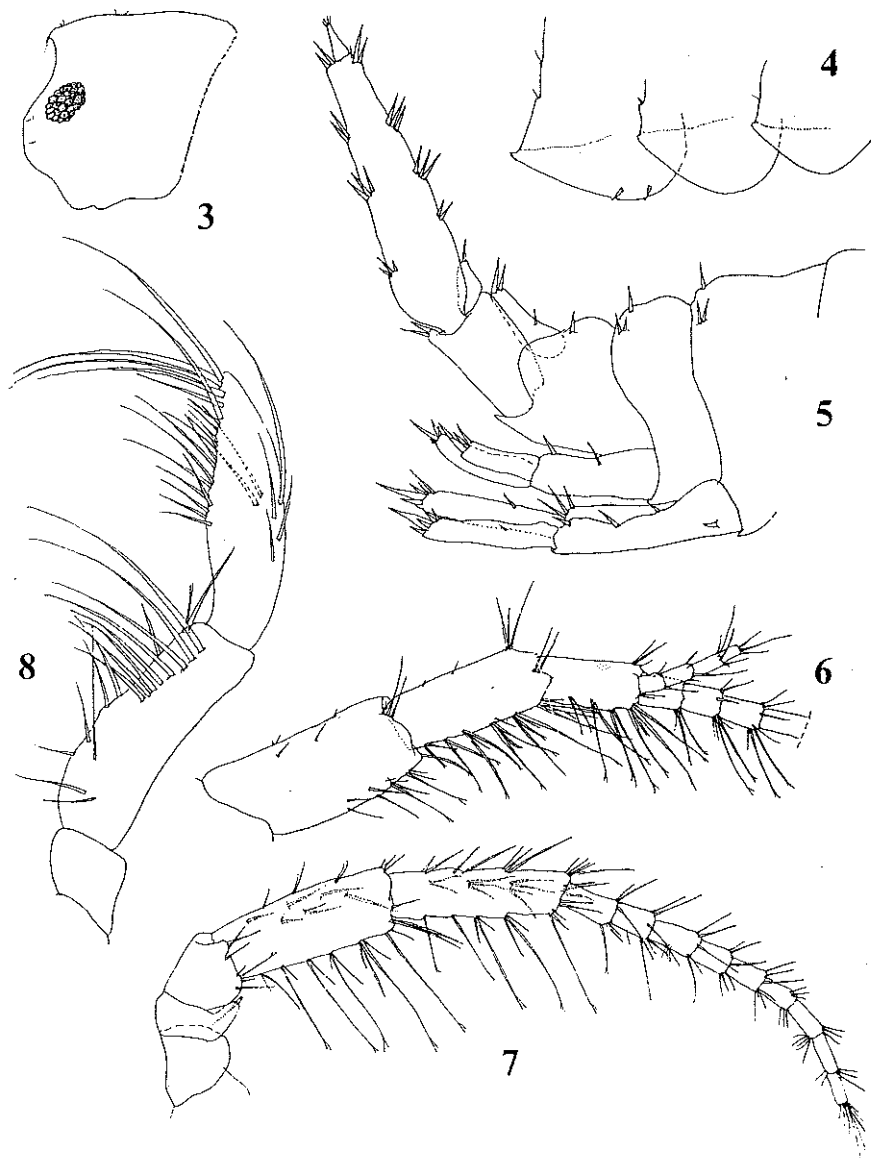
In conclusion, The genus *Lusigammarus* is considered a junior synonym of *Sarthrogammarus*, since the supposed differences simply do not exist. MARTYNOV, as early as 1935, discusses already (: 489-493) at length the evolutionary origin of *Sarthrogammarus* in the Sarmatian period of the Mediterranean area. His observations appear to me valid even today.

ACKNOWLEDGEMENTS

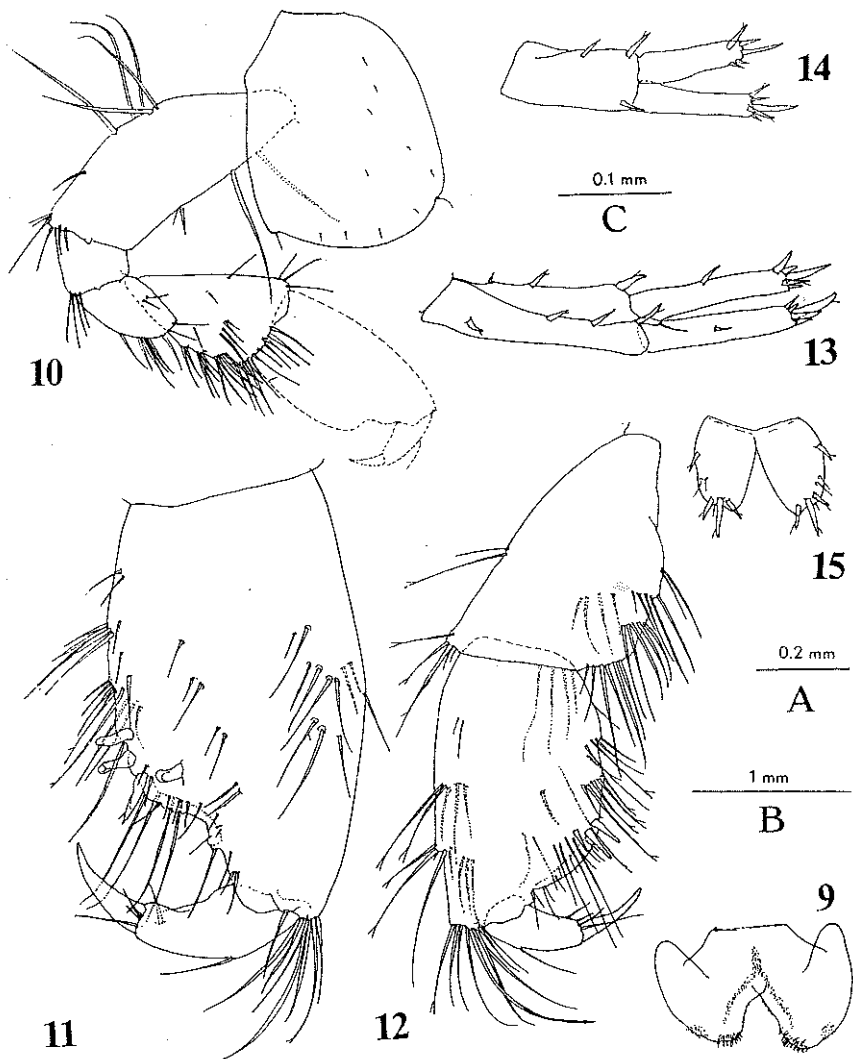
The fieldwork in 1991/92 wich yielded the specimens on which this note is based, was supported by a NATO (Brussels) Collaborative Grant, contract 880022. The Director, Dr. M. J. BISCOITO, and the former Director, Mr. G. E. MAUL, of the Museu Municipal do Funchal (Madeira, Portugal) are thanked for their hospitality during my stay on the island. Special thanks are due to Dr. A. D. ABREU (Funchal) and Mr. J. J. VERMEULEN (Amsterdam) for their highly efficient support during the preparation and the execution of the fieldwork.



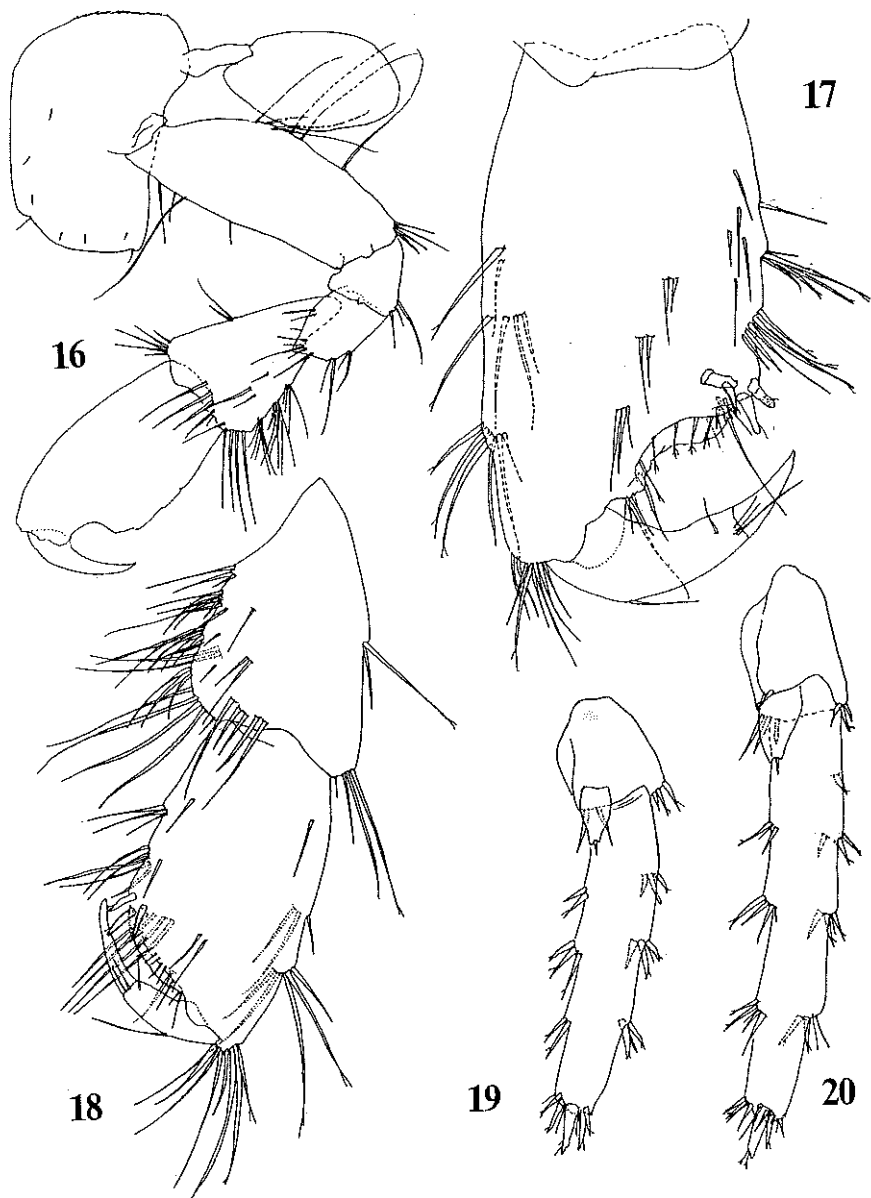
Figs. 1-2. *Sarthrogammarus madeirensis* (DAHL, 1958) (Madeira Stn. 92-45). 1 - merus and carpus of pereopod 3, ♀ ovig. (scale A); 2 - basis of pereopod 7, ♂ (A). Scale on one of the next spreads of figures.



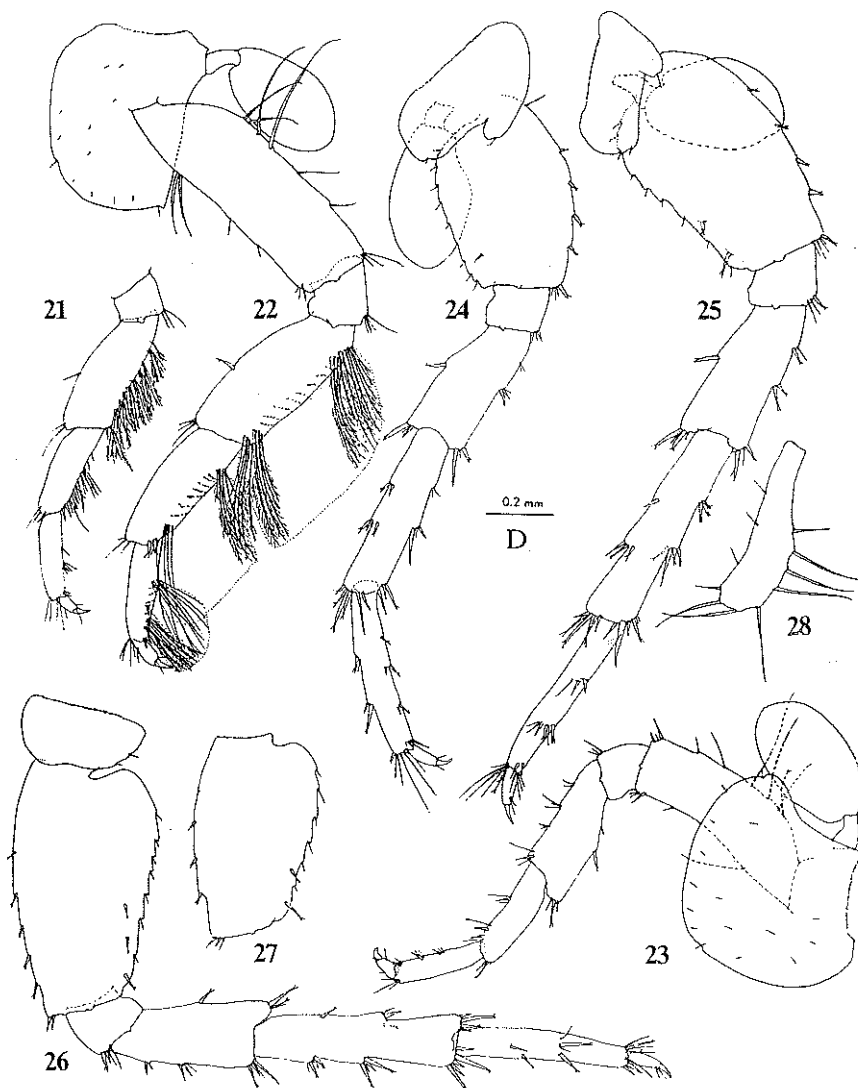
Figs. 3-8. *Sarothrogammarus cataractae* n.sp. (σ^7 paratype, Madeira Stn. 92-54): 3 - head, from the left (scale B); 4 - epimeral plates 1 to 3, from the right (B); 5 - urosome, from the right (A); 6 - basal part of antenna 1 (A); 7 - antenna 2 (A); 8 - mandible palp (C). Scales on the next spread of figures.



Figs. 9-15. *Sarothrogammarus cataractae* n. sp. (♂ paratype and ovig. ♀ allotype, Madeira Stn. 92-54): 9 - lower lip, ♂ (scale A); 10 - gnathopod 1, ♂ (A); 11 - propodus of gnathopod 1, ♂ (C); 12 - distal segments of gnathopod 1, ♀ (C); 13 - uropod 1, ♂ (A); 14 - uropod 2, ♂ (A); 15 - telson, ♀ (A).



Figs. 16-20. *Sarothrogammarus cataractae* n. sp. (♂ paratype and ovig. ♀ allotype, Madeira Stn. 92-54): 16 - gnathopod 2, ♂ (scale A); 17 - propodus of gnathopod 2, ♂ (C); 18 - distal segments of gnathopod 2, ♀ (C); 19 - uropod 3, ♀ (A); 20 - uropod 3, ♂ (A). Scales on previous spread of figures.



Figs. 21-28. *Sarothrogammarus cataractae* n. sp. (♂ paratype and ovig. ♀ allotype, Madeira Stn. 92-54): 21 - distal segments of pereopod 3, ♀; 22 - pereopod 3, ♂; long setae have their plumosity partly omitted); 23 - pereopod 4, ♂; 24 - pereopod 5, ♂; 25 - pereopod 6, ♂; 26 - pereopod 7, ♂; 27 - basis of pereopod 7, ♀; 28 - oostegite of gnathopod 2, ♀. All figures to scale D.

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