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THE TANAIDACEANS (ARTHROPODA: PERACARIDA: TANAIDACEA) OF SÃO MIGUEL, AZORES, WITH DESCRIPTION OF TWO NEW SPECIES, AND A NEW RECORD FROM TENERIFE

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ABSTRACT

During the Third International Workshop of Malacology and Marine Biology in São Miguel, Azores, in July 2006, sampling of the littoral and sublittoral benthos was undertaken in order to characterize the smaller marine arthropod fauna of this region, including tanaidaceans. In the event, 338 tanaidacean specimens representing three species were collected; two of these species, *Leptochelia caldera* and *Paratanais martinsi*, are new to science. In addition, previous tanaidacean material collected around São Miguel in 1996 and 1997 was analyzed, from which a further 272 specimens (three species, one not found in 2006) were identified. No apseudomorph tanaidaceans were found. All of the material is described, and an attempt is made to investigate the provenance of the Azorean tanaidacean fauna, although the general lack of data from the North-east Atlantic precludes any reasonable interpretation other than some possible links with the Mediterranean. However, recent material of *Zeuxo exsargasso* collected from Tenerife, in the Canary Islands, does suggest Macaronesian links with the West Atlantic.

RESUMO

Durante o 3º Workshop Internacional de Malacologia e Biologia Marinha em São Miguel, Açores, em Julho de 2006, fizeram-se amostragens do bentos litoral e sublitoral de modo a caracterizar a fauna de pequenos artrópodes marinhos dessa região, incluindo os tanaidáceos. Assim, recolheream-se 338 espécimens de tanaidáceos representando três espécies; duas dessas espécies, *Leptochelia caldera* e *Paratanais martinsi*, são novas para a ciência. Para além disso, analisou-se material recolhido previamente à volta de São Miguel em 1996 e 1997, do qual foram identificados 272 especimens (três espécies, uma das quais não encontrada em 2006). Não se encontraram tanaidáceos apseudomorfos. Todo o material foi descrito, e abordou-se a questão da proveniência da fauna tanaidácea Açoreana, embora a ausência generalizada de dados do Nordeste Atlântico impeça qualquer interpretação razoável para além de algumas possíveis ligações com o Mediterrâneo. No entanto, material recente de *Zeuxo exsargasso* recolhido em Tenerife, Ilhas Canárias, sugere ligações Macaronésicas com o Atlântico Oeste.

INTRODUCTION

The Azores are a group of islands somewhat isolated in the north-east Atlantic, lying adjacent to the Mid-Atlantic Ridge some 1300 km west of Portugal and 1730 km southeast of Newfoundland. The main surface water currents reaching the archipelago bring waters from two directions: the Azores Drift, a diffuse southerly arm of the Gulf Stream breaking off from the North Atlantic Drift supplies water from the Americas, while the somewhat less-significant western eddies of the Canary Current bring waters from Spain and North Africa; below these, the midwater current brings warm, hyperhaline water

from the Mediterranean outflow (Gofas, 1990; Morton *et al*., 1998). This hydrography clearly has implications for the colonization of the islands by benthic marine species.

Tanaidaceans are a group of the arthropods with minimal dispersive ability; the larvae are not planktonic, and there are only limited examples of adults swimming (Bamber, 1998). Some species are known to have spread in fouling communities on ship's hulls (Bamber, 1977), and others are known to live in floating algae (Sieg, 1980) or ectoparasitically on turtle tests and on manatees (see Morales-Vela *et al*., 2008). It is therefore of some interest to determine the suite of species which has colonized the Azores archipelago, and their provenance.

Previous records of tanaidaceans from the Azores are very sparse, and largely incidental, although Dollfus (1897) reported on the tanaidacean material collected around the Azores during the cruise of the *Hirondelle* in 1887 and 1888. All but two of the species recorded *in litt*. are from deep-water (>100 m; mostly >500 m). Dollfus (1897) reported *Leptochelia savignyi* Krøyer, 1842 from Horta; despite the controversy regarding earlier records of sibling species of this taxon, Dollfus' records appear to be substantiated (see below); *L. savignyi* was described originally from Madeira, so its occurrence in the Azores is not surprising. Dollfus (1897) also recorded *Tanais dulongii* (Audouin, 1826) (as *Tanais cavolinii* Milne-Edwards, 1828) from Baïe de Fayal, and described as new *T. grimaldii* from Horta, distinguishing the two on the shape of the cephalon (his new species having a shorter cephalon) and the number of uropod articles; there is doubt whether his *T. dulongii* specimens were in fact of that species (see below); Morton *et al*. (1998) mention the occurrence of *Tanais* in littoral algal mats. Finally, the record of "*Paratanais atlanticus*" of Dollfus (1897) is *incertae sedis*, but not attributable to *Paratanais* (see below).

The nine confirmed species recorded from around the Azores are:

Suborder Apseudomorpha
Leviapseudes leptodactylus (Beddard, 1886), Azores 1830 m.

Suborder Tanaidomorpha
Superfamily Tanaoidea
Tanais grimaldii Dollfus, 1897, Azores, littoral, 5-6 m.

Superfamily Paratanaoidea
Siphonolabrum mirabile Lang, 1872, Azores 3500-4165 m.
Agathotanais hanseni Lang, 1971, E. Pacific & Azores, 2861-4165 m
Leptognathia abyssorum (Dollfus, 1897), Azores, 1287 m.
Paratyphlotanais richardi (Dollfus, 1897), W Ireland, Azores, 699-1287 m.
Typhlotanais spiniventris Dollfus, 1897, Azores, 130-1287 m.
Mesotanais dubius Dollfus, 1897, Azores, 1287 m.
Leptochelia savignyi Krøyer, 1842, Azores, 5 to 6 m.

During the Third International Workshop of Malacology and Marine Biology at Vila Franca do Campo, São Miguel, in July 2006, sampling of the littoral and sublittoral benthos was undertaken in order to characterize the smaller marine arthropod fauna of this region, including tanaidaceans. In the event, 338 specimens representing three species were collected; two of these species are new to science. In addition, a previous collection from around the island was made available, from which a further 272 specimens (three species, one additional to the above three) were identified. No apseudomorph tanaidaceans were found.

In addition, recently collected material from Tenerife, in the Canary Islands, kindly supplied to us by Brian Morton, revealed a new record of a tanaidacean, relevant to the origins of the Macaronesian fauna. All of the material is described below.

MATERIAL AND METHODS

The present Azores material comes from two sources. During the Workshop at Vila Franca do Campo in July 2006, a number of littoral and infralittoral habitats on the island of São Miguel were sampled for tanaidaceans, including crevice habitats, macroalgae and soft sediments. The principal sampling areas were the littoral sediments, rocks and algae below the Clube Naval building (the old Vila Franca do Campo abattoir); the sediments and algae within the caldera of the Ilhéu de Vila Franca; and the soft sediments off Vila Franca do Campo (ca N37º 43′ W25º 25′), from 12 to 200 m depth. Offshore sediments were sampled using a 0.025 m^2 van Veen grab and various dredges. All samples were washed through a 0.5 mm mesh sieve, and specimens sorted alive. Some of these specimens were fixed in absolute ethanol to allow DNA analysis.

Extensive material collected in 1996 and 1997, from 11 (1996) and 20 (1997) infralittoral rocky-substratum sites around São Miguel, was also analysed in detail. Samples of algae (*Stypocaulon scoparia*, *Halopteris filicina* and *Zonaria tournefortii*) were collected by SCUBA diving at depths from between 5 and 16 m. Details of the sampling and protocols are given by Costa & Ávila (2001). The sampling sites, anti-clockwise around the Island from the north-west, were Mosteiros, Ponta da Ferraria, Santa Clara, Pesqueiro, Emissário, Sinaga, Atalhada, Ribeira da Praia, Caloura, Porto de Vila Franca do Campo, Ilhéu de Vila Franca, Ribeira Quente, Faial da Terra, Nordeste, Porto Formoso, Ladeira de Velha, Ribeirinha, Lactoaçoreana, Cofaco and São Vicente. These sites variously represented exposed and sheltered shores, undisturbed, naturally disturbed (near shallow-water vent sites or stream mouths) and polluted shores.

Finally, a collection of littoral algal turf was made from a rocky intertidal platform at Playa de Fanabe, Costa Adeje, Tenerife, Canary Islands, in June 2007, from which a further species not found in the São Miguel material was extracted.

Terminology used herein recognizes the first pair of antennae as antennules, the second pair as the antennae. The first maxilla is termed the maxillule. The first pair of pereopods (of six) is the pair immediately posterior to the chelipeds. Serially repetitive body-parts, such as the pereonites and subdivisions of antennal flagella are segments, others (such as the parts of the limb) are articles. Total length is measured axially from the tip of the rostrum to the posterior edge of the pleotelson; measurements were made dorsally on the body and antennules, and laterally on the pereopods and antennae. The term ‘spines’ is used in the traditional sense to distinguish between rigid ‘thorn-like’ structures and the more flexible ‘hair-like’ setae (in keeping with their etymology and all historic literature); non-articulating spine-shaped extensions of the cuticle are considered to be apophyses; comb–rows of fine setules, occasionally present on maxillae and pereopod articles, *inter alia*, are referred to as microtrichia.

Voucher and type-material has been lodged in the collections of The Natural History Museum, London (NHM). The higher taxonomy is based on Guțu & Sieg (1999).

SYSTEMATICS

SÃO MIGUEL MATERIAL

Suborder TANAIDOMORPHA Sieg, 1980
Superfamily Tanaoidea Dana, 1849
Family Tanaidae Dana, 1849
Subfamily Tanainae Dana, 1849
Genus *Tanais* Latreille, 1831

Tanais grimaldii Dollfus, 1897
Figure 1A, B

Sieg, 1980, pp. 84-91; Figure 31, 22.

Material: 1 female with oostegites, 1 female with empty brood pouch, 2 subadult females, 2 neuters, 1 manca (Registration N^{os} NHM.2007.764-771), Isl. 24.2, drift algae within the flooded crater of the Ilhéu de Vila Franca, 24 July 2006, coll. A. Salvador, R. Robbins & R.B.; 12 females with oostegites, 4 brooding females, 6 males, 148 neuters, 24 mancae (NHM.2007.772-781), Isl. 24.4, attached low-littoral algae, south wall of the flooded crater of the Ilhéu de Vila Franca, 24 July 2006, coll. A. Salvador, R. Robbins & R.B.; 4 females with oostegites, 1 brooding female, 4 males, 31 subadult females, 42 neuters, 28 mancae, Isl. 24.5, mid-lagoon algae, within the flooded crater of the Ilhéu de Vila Franca, 24 July 2006, coll. A. Salvador, R. Robbins & R.B.; 2 neuters, 2 mancae (NHM.2007.782-785), WVF011, northeastern side of Ilhéu de Vila Franca do Campo, 16 m, scuba dive collection by Gonçalo Calado, José Pedro Borges, Joana Xavier, Paola Rachello, Patrícia Madeira, 20 July 2006.

1 brooding female, 1 neuter, 1 manca II, Mosteiros, 17 June 1997; 1 neuter, 1 manca II, Ponta da Ferraria, 17 June 1997; 3 females (1 brooding), 2 males, 1 manca, Emissário, 2 November 1996; 1 manca, Atalhada, 30 May 1997; 1 female, 4 neuters, 15 mancae, Caloura, 26 June 1997; 5 neuters, 1 manca, Ribeira Quente, November 1996; 1 manca, Ribiera Quente, 18 June 1997; 1 manca, Nordeste, 21 November 1996; 1 male, 1 brooding female, 1 neuter, 2 mancae. Nordeste, 2 May 1997; 1 female, Porto Formoso, 30 October 1996; 4 males, 1 female with oostegites, 3 neuters, 2 mancae, Porto Formoso, 19 June 1997; 2 males, 3 mancae, Ladeira da Velha, 19 June 1997; 4 females (1 brooding, 2 with oostegites), 1 male, 4neuters, 1 manca, Ribeirinha, 8 October 1996; 2 females with oostegites, 7 neuters, 5 mancae, Ribeirinha, 25 June 1997; 4 females (1 brooding), 8 neuters, 9 mancae, Lactoaçoreana, 25 June 1997; 1 male, 1 female, Cofaco, 7 October 1996; 4 females (1brooding), 7 males, 6 neuters, 1 manca, São Vicente, 7 October 1996; 3 females, 3 neuters, 6 mancae, São Vicente, 6 May 1997. All coll. A.C.C. & João Brum.

Remarks: Tanais grimaldii is one of the only two littoral tanaidacean species recorded previously from the Azores: the type-locality is Horta (Faial), at 5 to 6 m depth (Dollfus, 1897). *T. grimaldii* is distinguished from its only northeast Atlantic congener, *T. dulongii* (Audouin, 1826) by the conformation of the laciniae mobili of the mandibles (see Sieg, 1980, Figure 31), but also adults of the present species have one more article in the uropod (basis plus three-segmented endopod: Figure 1B) than does *T. dulongii* (basis plus two-segmented endopod). Dollfus (1897) also recorded *Tanais dulongii* (Audouin, 1826) (as *Tanais cavolinii* Milne-Edwards, 1828) from Baie de Fayal, distinguishing it and *T. grimaldii* on the shape of the cephalon (his new species having a shorter cephalon) and the number of uropod articles; it is unclear whether his specimens of putative *T. dulongii* were fully mature, as only adult *T. grimaldii* have four segments to the uropod endopod (*T. dulongii* can be distinguished from immature *T. grimaldii* with three-segmented

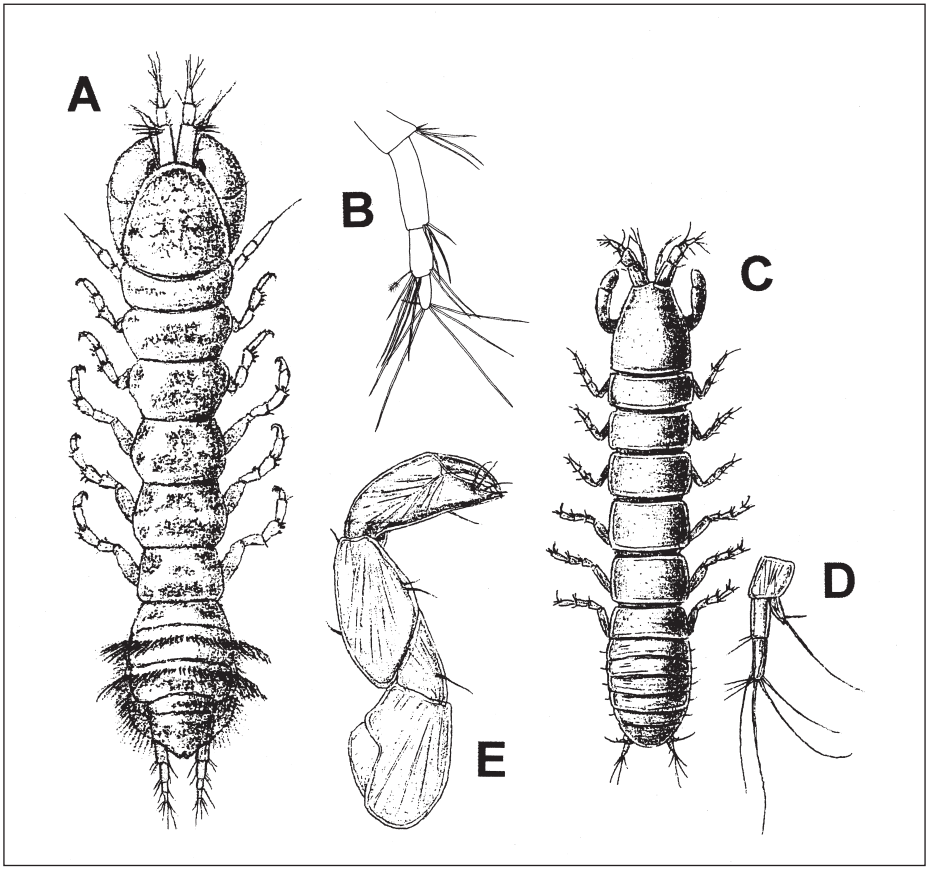

FIGURE 1. A, B, *Tanais grimaldii* Dollfus, 1897: A, dorsal; B, uropod; C to E, *Leptognathia breviremis* (Lilljeborg, 1864): C, dorsal; D, uropod; E, cheliped. (A redrawn after Sars, 1886; B, Azores specimen; C to E modified from Sars, 1899).

endopods, as the penultimate segment is twice as long as the ultimate segment in the former, only slightly longer in the latter). Dollfus did not examine the mandibular structure, and indeed would have been unaware of its significance.

It is likely that all previous records of *Tanais dulongii* from the Azores in fact refer to *T. grimaldii*. The present species is also recorded from the Italian Mediterranean (Gulf of Naples, Ischia and Linosa); there are unconfirmed records from the western Mediterranean and Casablanca (Sieg, 1980).

All the material reported above was collected from algae at less than 17 m depth. Brooding females and mancae were present in all the months sampled (May, June, July, October and November).

Superfamily Paratanaoidea Lang, 1949
Family Anarthruridae Lang, 1971
Subfamily Leptognathiinae Sieg, 1976
Genus *Leptognathia* Sars, 1882

cf. *Leptognathia breviremis* (Lilljeborg, 1864)
Figure 1C to E

Material: 1 headless specimen, Ponta da Ferraria, 17 June 1997, coll. A.C.C. & João Brum.

This damaged specimen is almost unidentifiable; the cheliped and uropods are appropriate to *L. breviremis*. This species is known from the eastern North Atlantic, but has been recorded (dubiously) from the North Pacific. A figure of *L. breviremis* (modified from Sars, 1899) is given to aid possible recognition of this taxon in the Azores in future (Figure 1, C to E).

Family Leptocheliidae Lang, 1973
Genus *Leptochelia* Dana, 1849
Leptochelia caldera sp. nov.
Figures 2, 3

Material: 1 female with oostegites, holotype (NHM.2007.424), 1 male, allotype (NHM.2007.425), 13 females, paratypes (NHM.2007.426-435), Isl. 24.4, attached low-littoral algae, south wall of the flooded crater of the Ilhéu de Vila Franca, 24 July 2006, coll. A. Salvador, R. Robbins & R.B.; 2 females, paratypes (NHM.2007.436-437), Isl. 24.5, mid-lagoon algae, within the flooded crater of the Ilhéu de Vila Franca, 24 July 2006, coll. A. Salvador, R. Robbins & R.B..

2 females, Pesqueiro, 7 November 1997; 3 males, 32 females (3 brooding), 5 neuters, Emissário, 2 November 1996; 3 females, 1 male, Emissário, 12 June 1997; 1 manca, Sinaga, 30 May 1997; 4 males, 40 females (2 brooding), 9 neuters, 2 mancae, Atalhada, 25 October 1996; 1 male, 14 females, 7 neuters, Atalhada, 30 May 1997; 1 female, Caloura, 26 June 1997; 1 neuter, Faial da Terra, 12 June 1997; 1 female, 1 neuter, Nordeste, 12 May 1997; 1 male, 1 neuter, Ribeirinha, 8 October 1996; all coll. A.C.C. & João Brum.

Description of female: body (Figure 2A) slender, holotype 3.6 mm long, 7.3 times as long as wide. Cephalothorax subrectangular, 1.6 times as long as wide, as long as pereonites 2 and 3 together, with slight rostrum, eyelobes rounded, eyes present and black, single setae at posterior of eyelobes and posterolaterally. Six free pereonites; pereonite 1 shortest, pereonites 2 and 3 subequal, 1.3 times as long as pereonite 1; pereonites 4 and 5 subequal (pereonite 4 longest) and 1.25 times as long as pereonite 2; pereonite 6 just longer than pereonite 1 (all pereonites respectively 1.9, 1.4, 1.3, 1.1, 1.0 and 1.4 times as wide as long). Pleon of five free subequal pleonites bearing pleopods; each pleonite about 3.5 times as wide as long, with paired lateral setae. Pleotelson (Figure 2M) semicircular, 0.16 times as long as pleon, 2.8 times as wide as long, with paired lateral setae, paired posterolateral setae on each side and two distal setae.

Antennule (Figure 2D) of four tapering articles, proximal article 3.6 times as long as wide, 1.5 times as long as distal three articles together, with two long outer and single short dorsal and inner setae; second article twice as long as wide, distal outer seta shorter than article; third article 1.3 times as long as second and with one aesthetasc; fourth article minute, eccentric, with five distal setae.

Antenna (Figure 2G) of six articles, proximal article compact, naked; second article as long as wide, with single ventrodistal and dorsodistal slender spines; third article 1.3 times as long as wide, with dorsodistal slender spine; fourth article longest, three times as long as wide; fifth article half as long as fourth; sixth article minute.

Labrum (Figure 2H) rounded, setose, typical of genus. Left mandible (Figure 2I) with crenulate lacinia mobilis wider than pars incisiva, proximal crenulation

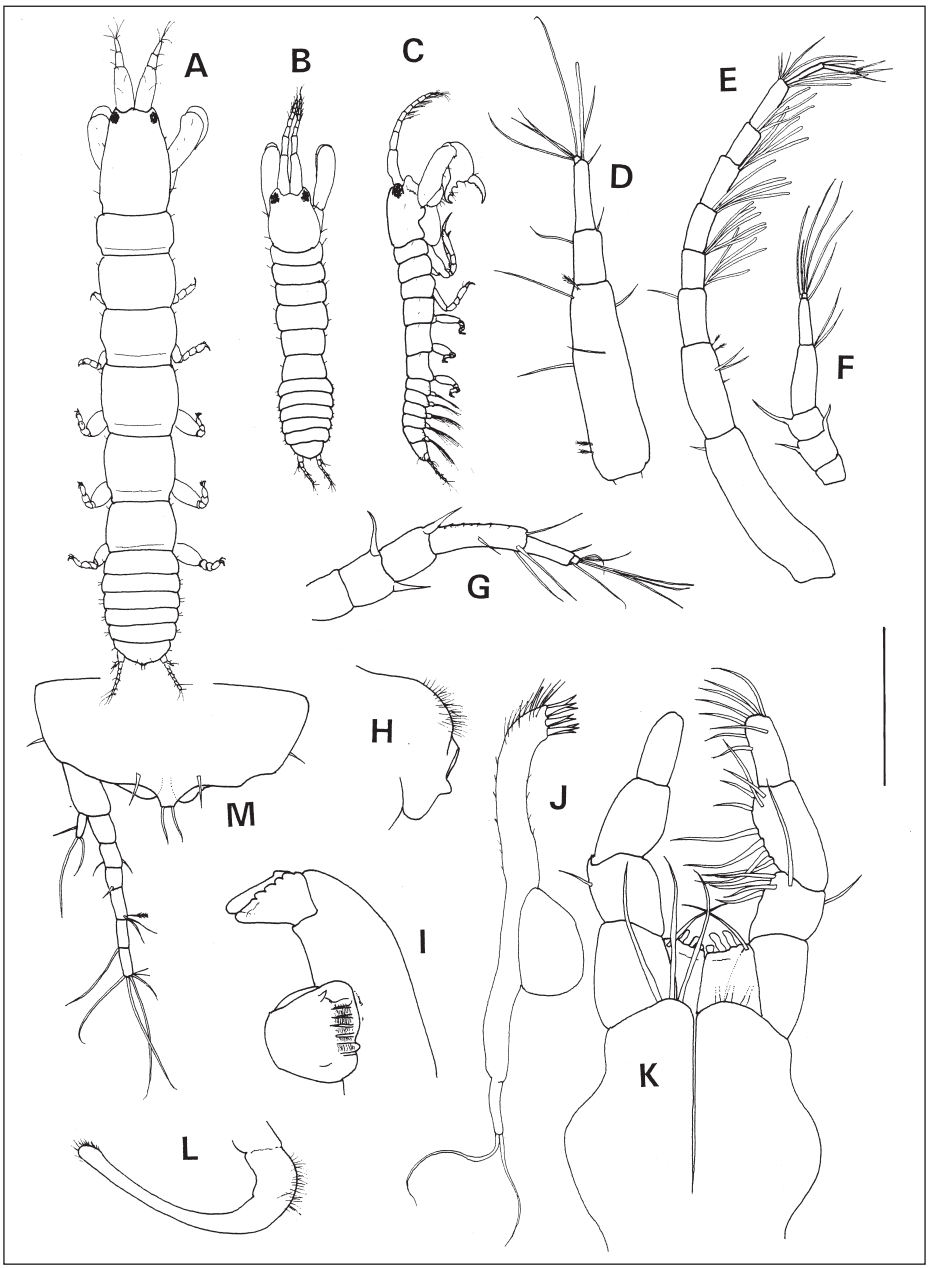

FIGURE 2. *Leptochelia caldera* sp. nov., A, holotype female, dorsal; B, allotype male, dorsal; C, allotype male, lateral; D, female antennule; E, male antennule; F, male antenna; G, female antenna; H, labrum, lateral; I, left mandible; J, maxillule and maxilla; K, maxilliped; L, epignath; M, pleotelson and left uropod. Scale line = 1 mm for A, B and C, 0.2 mm for D to G and M, 0.1 mm for H to L.

on pars incisiva, pars molaris with strong rugosity; right mandible similar but without lacinia mobilis. Labium typical of genus, distally finely setose, without palp. Maxillule (Figure 2J) with seven long and two short distal spines and setose margins; palp of two articles with two distal setae; maxilla simple, ovoid. Maxilliped (Figure 2K) palp first article naked, second article with one outer and three inner setae, and distal seta exceeding distal margin of third palp article; third and fourth articles with filtering rows of six and seven setae respectively, third article with two further inner distal setae, fourth article with submarginal outer seta; basis with three long setae extending to third palp article; endites distally with single outer seta and one inner rounded and two robust spatulate spines. Epignath (Figure 2L) elongate, arcuate, with setose margin distally and proximally.

Cheliped (Figure 3A) with rounded, compact basis 1.9 times as long as wide, with inner distal seta; merus subtriangular with three ventral setae; carpus 1.9 times as long as wide, with three midventral setae; propodus typical for the genus, fixed finger with three ventral and three inner setae, cutting edge crenulate, setal row at base of dactylus of three setae; dactylus with proximal seta.

Pereopod 1 (Figure 3C) longer than other pereopods, coxa with seta and rounded apophyses; basis slender, 4.1 times as long as wide, with dorsoproximal seta; ischium compact with one seta; merus just shorter than carpus; carpus with three distal setae, longest of which is 0.4 times length of propodus; propodus as long as carpus and merus together, with three dosrodistal setae on slight mound, one ventrodistal seta; dactylus slender, extending into shorter slender unguis, the two together as long as propodus. Pereopod 2 (Figure 3D) more compact than pereopod 1; basis 3 times as long as wide; ischium with 2 setae, longer seta longer than ischium width; merus longer than carpus, merus with strong ventrodistal spine, carpus with shorter ventrodistal spine; propodus with paired dorsodistal setae and ventrodistal spine; merus, carpus and propodus with ventral microtrichia; dactylus and short unguis together 0.6 times as long as propodus; dactylus (Figure 3E) with collar of fine setules at half length and dorsodistal setule. Pereopod 3 (Figure 3F) similar to pereopod 2, including longer seta on ischium and dactylus setulation, but carpus longer than merus and with short outer distal seta.

Pereopod 4 (Figure 3G) basis stout, 2.4 times as long as wide; ischium with two short setae; merus shorter than carpus, merus with two short, ventrodistal spines, carpus with outer, ventral and inner curved distal spines; propodus longer than carpus, with two ventrodistal short spines, four dorsodistal setae, one as long as dactylus; dactylus and unguis partially fused into a claw, curved. Pereopods 5 (Figure 3H) and 6 as pereopod 4, but with pereopod 5 propodus with fewer distal setae.

Pleopods all alike, typical for the genus, with single dorsal plumose seta on basis.

Uropod (Figure 2M) biramous, basis naked; exopod of one segment, 0.7 times as long as proximal endopod segment, outer distal seta longer than inner distal seta; endopod of six segments, distal segments slender.

Description of male: typical primary male, half length of female (allotype length 1.7 mm), body (Figure 2B, C) more compact, cephalon just longer than pereonites 1 to 3 together, with large eyelobes bearing conspicuous black eyes; pereonite 1 shortest, pereonites 2 to 6 progressively

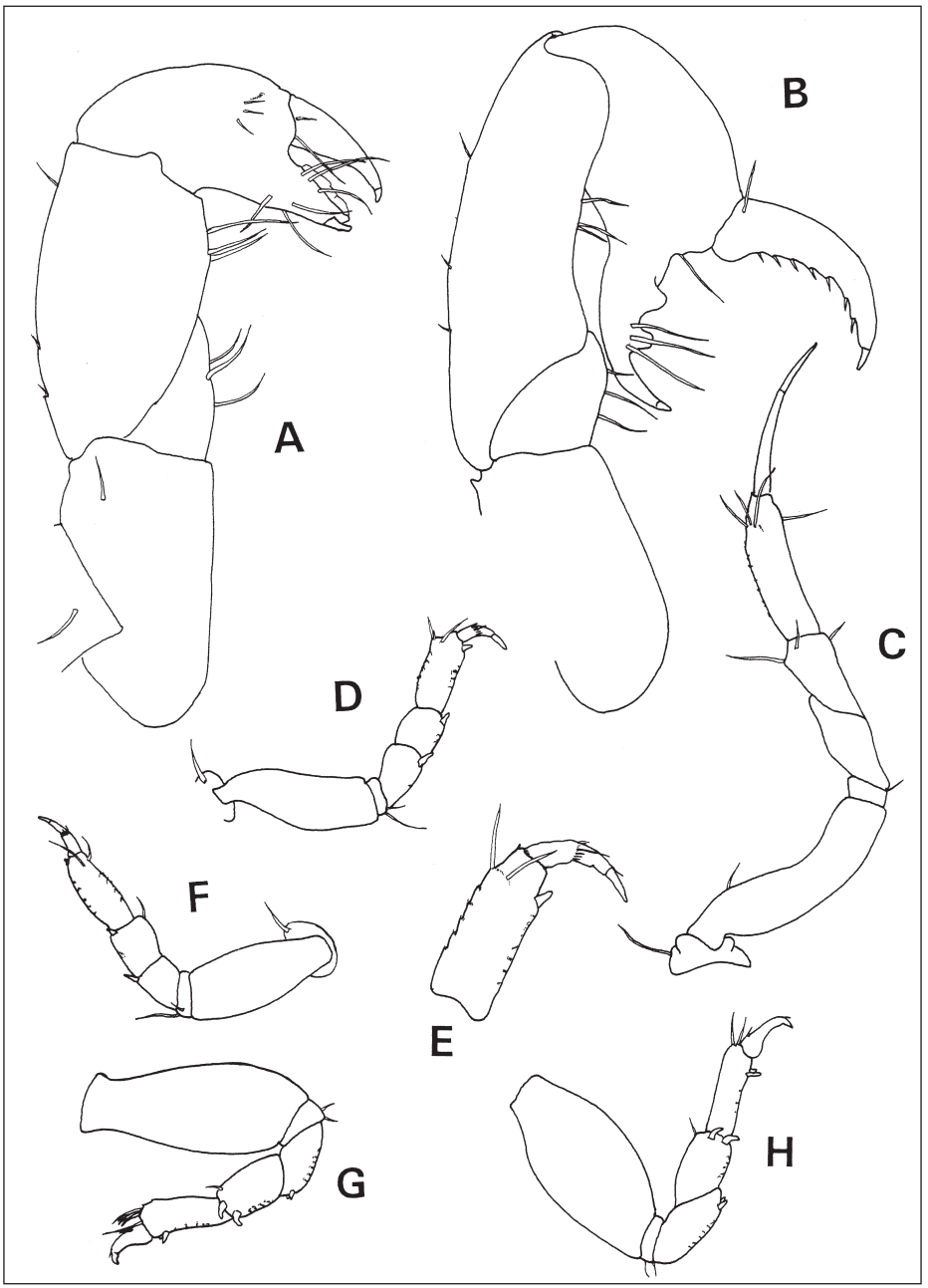

FIGURE 3. *Leptochelia caldera* sp. nov., A, female cheliped; B, male cheliped; C, pereopod 1; D, pereopod 2; E, detail of distal articles of pereopod 2; F to H, pereopods 3, 4 and 5 respectively. Scale line = 0.2 mm for A to D and F to H, 0.1 mm for E.

longer, pereonite 4 1.7 times as long as pereonite 1. Five free pleonites, subequal in length, pleotelson just longer than pleonite 5. Sexual dimorphism as follows.

Antennule (Figure 2E) elongate, first peduncle article arcuate, 4 times as long as wide; second article 0.6 times as long as first with ventrodistal penicillate setae and 2 midventral simple setae; third article 0.6 times as long as second, with dorsodistal seta; flagellum of 7 segments, first with 4 proximal and 5 distal aesthetascs, segments 2 to 5 with 4, 4, 3 and 3 distal aesthetascs respectively; segments 6 and 7 more slender than others. Antenna (Figure 2F) similar to that of female but more compact. Mouthparts atrophied.

Cheliped (Figure 3B) larger than that of female; carpus slender, 3.6 times as long as wide, with ventrodistal invagination to accommodate propodus on reflexion; propodus fixed finger shorter than palm, with two inner tooth-like apophyses on cutting edge; moveable finger with spinules along cutting edge.

Pleopods more setose than those of female.

Etymology: *caldera* (from the Spanish cauldron) is a volcanic crater, the 2006 type-material of this species having been collected from the sea-water-flooded crater of Ilhéu de Vila Franca.

Remarks: there are four recorded species of *Leptochelia* with only 3 maxilliped basis setae, none of them occurring in the North Atlantic or Mediterranean, viz. *L. itoi* Ishimaru, 1982 (from Japan), *L. lusei* Bamber & Bird, 1997 (from Hong Kong), *L. nobbi* Bamber, 2005 (from Western Australia) and a species from Queensland, Australia (Bamber, in press). Of these four, only *L. nobbi* has a proximal antennule article more than 3 times as long as wide, but that species has a compact basis to pereopod 1 (only three times as long as wide) and a uropod exopod only half as long as the proximal endopod segment length. Despite its much more compact proximal antennule peduncle article (2.5 times as long as wide), *L. itoi* shows most similarity to *L. caldera* sp. nov., but the cheliped basis of the Japanese species is more compact (1.5 times as long as wide), the distal seta of antennule peduncle article 2 is as long as the article (shorter in *L. caldera*), and the dactylus plus claw of the first pereopod is much longer than the propodus (1.33 times as long, compared with subequal in length in *L. caldera*).

The number of maxilliped basis setae in *L. neapolitana* Sars, 1882 is not known, but that species again differs from *L. caldera* in that the proximal antennule peduncle article is shorter (three times as long as wide), the uropod exopod is less than half the length of the proximal endopod segment, the dactylus plus claw of the first pereopod is much longer than the propodus (1.36 times as long) and the cheliped basis more compact (1.35 times as long as wide).

The male of the present species is generally very similar to the male of *L. dubia sensu* Sars, 1886 (non Krøyer, 1842), but that species has longer anterior pereonites, and is without the degree of ventrodistal invagination on the cheliped carpus shown by *L. caldera* (and the female of Sars' species has five maxilliped basis setae). The male of *L. neapolitana* has a similar cheliped to the present species, but has fewer antennule flagellum segments and more attenuate pereonites.

None of the species described previously has the peculiar collar of setules at half length on the dactylus of pereopods two and three shown by *Leptochelia caldera*.

Dollfus (1897) recorded a male and a female of *Leptochelia savignyi* Krøyer, 1842 from Horta at 5 to 6 m depth. This taxon has been the subject of some confusion over the last 150 years (including erroneous synonymy with *L. dubia* Krøyer, 1842), and it is now apparent that numerous species of *Leptochelia* await distinction based on morphological features of both genders which were not examined in any detail before Ishimaru (1985) (see Bamber, 2005 for discussion). From his subsequent report on Mediterranean and Atlantic species (Dollfus, 1898), it is apparent that Dollfus distinguished *L. savignyi* correctly on the basis of four longer articles in the antennule of the female (*inter alia*). There is debate whether the extra antennular article is an intermediate feature of a female changing into a male in a genus known to show progynous hermaphroditism (e.g. Smith, 1906); while this trend has been observed in some taxa of *Leptochelia* (R. Heard, pers. comm.), the male of *L. savignyi sensu* Sars, 1886 is a primary male, while Larsen & Rayment (2002) found this antennular structure a consistent feature of females of their new species *L. elongata*, including an ovigerous paratype. Dollfus (1898) reported a number of collections including females attributed to *L. savignyi* from the Mediterranean and the eastern Atlantic, implying a frequency of this antennular morphology unlikely to be shown only by transitional hermaphrodite specimens. His records from the Azores are thus accepted as valid, and *L. savignyi sensu* Sars, 1886 (see Figure 6A, B) is accepted as the same as *L. savignyi* Krøyer, 1842.

Krøyer (1842) named a third species of *Leptochelia*, "*Tanais*" *edwardsii*, also from Madeira, but based only on the male. While it is possible that this taxon may never be confirmed (it is assumed to be the male of *L. savignyi*), from his figure (Krøyer, 1842: pl.2: Figures 13-19) it does not have the same antennular or pleotelson proportions as *L. caldera*.

Family Paratanaidae Lang, 1949
Sufamily Paratanaidinae Lang, 1949
Genus Paratanais Dana, 1852

Paratanais martinsi sp. nov.
Figures 4, 5

?*Paratanais euelpis* Monod, 1925, non *Paratanais euelpis* Barnard, 1920.
Non- *Paratanais atlanticus* Dollfus, 1897 (*incertae sedis*)

Material: 1 female with brood pouch (in tube), holotype (NHM.2007.438), 1 female dissected, 2 females, 1 manca, 1 headless female, paratypes,(NHM.2007.439-440), WVF040, off Amora, Ponta Garça, São Miguel, Azores, 37º42'720"N 25º21'554"W, 37.8 m depth, small dredge sample, 26 July 2006, coll. António de Frias Martins & Jerry Harasewych.

Description of female: body (Figure 4A) elongate, slender, 4.2 mm long, eight times as long as wide, colour translucent white, eyes black. Cephalothorax subrectangular, 1.2 times as long as wide, with slight rounded rostrum, single mid-lateral setae; eyes present, pigmented. Six free cylindrical pereonites; pereonite 1 shortest, with single anterolateral setae; pereonites 2 and 3 subequal, twice as long as pereonite 1, also with single anterolateral setae; pereonites 4 and 5 subequal (pereonite 4 longest), 1.2 times as long as pereonite 2, pereonite 6 just shorter than pereonite 2 (all pereonites respectively 2, 1.1, 1.0, 0.9, 0.9 and 1.2 times as wide as long). Pleon of five free subequal pleonites bearing pleopods; pleonites 4.5 times as wide as long; pleonites 1 to 4 with one plumose, articulating lateral seta on each side, pleonite 5 with simple lateral seta.

Pleotelson semicircular, short, 1.9 times as wide as long, distally with paired dorsal and paired terminal setae.

Antennule (Figure 4B) of four articles, proximal article 2,3 times as long as wide, second article 1.3 times as long as wide, about one-third length of first, with dorsal seta longer than article length; third article nearly two-thirds length of second; distal article slender, longer than second and third articles together, with five distal setae and single aesthetasc.

Antenna (Figure 4C) of six articles, proximal article compact, naked; second article with long ventrodistal and short dorsodistal apophyses each bearing seta; third article as long as wide, naked, with dorsodistal spine; fourth article just longer than second, with two distal simple setae; fifth article half as long as fourth with two distal setae; sixth article minute with five longer and one shorter distal setae.

Labrum (Figure 4D) apically rounded, setose. Left mandible (Figure 4E) with crenulate pars incisiva and wide, crenulate lacinia mobilis; pars molaris robust with elaborate marginal "teeth". Right mandible (Figure 4F) without lacinia mobilis, pars molaris less elaborate. Labium (Figure 4G) simple, finely setose, with fine outer marginal spinule, without palp. Maxillule (Figure 4H) with seven longer and two shorter distal spines, palp slender with two long distal setae; maxilla ovoid, naked. Maxilliped (Figure 4I) endites characteristic of genus, wide with denticulate outer margin, two inner distal ovate tubercles and single inner seta; palp first article naked, second article inner margin with two simple setae and shorter distal spine, outer margin with distal seta; third article with three inner bidenticulate spines, adjacent shorter simple spine; fourth article with four inner bidenticulate spines, single inner submarginal and outer simple setae; single inner spine on basis exceeding distal margin of endites. Epignath (Figure 4J) ribbon-like, glabrous but with two fine distal setae.

Cheliped (Figure 5A) compact, carpus 1.2 times as long as wide; propodus wider than long, fixed finger short with lamellate apophyses on cutting edge, terminal spine indistinct; dactylus with dorsoproximal simple seta.

Pereopod 1 (figue 5B) longer than others, coxa simple with seta; basis slender, arcuate, five times as long as wide; ischium compact with single seta; merus 1.5 times as long as carpus; propodus 1.2 times as long as merus, with one ventral and three dorsal distal setae; dactylus with distinct, slender claw, both together as long as propodus. Pereopod 2 (Figure 5C) similar to pereopod 1, but more compact, basis 3.1 times as long as wide, ischium with tow setae, merus shorter than carpus with ventral microtrichia and ventrodistal spine, carpus with ventral microtrichia, two ventrodistal and one larger inner distal spines. Pereopod 3 (Figure 5D) similar to pereopod 2. Pereopod 4 (Figure 5E) basis robust, 2.2 times as long as wide; merus 0.8 times as long as carpus, each with spination as pereopod 3; propodus longer than carpus with mid-dorsal penicillate seta, dorsodistal slender spine and ventrodistal stout spine; dactylus and claw forming unguis, curved, two-thirds as long as propodus. Pereopod 5 (Figure 5F) as pereopod 4. Pereopod 6 (Figure 5G) as pereopod 4, but propodus more compact with two ventrodistal spines and three dorsodistal setae adjacent to slender spine.

Pleopods (Figure 4K) all alike, with naked basis, endopod with single inner plumose seta; exopod without setae on inner margin.

Uropod (Figure 5H) basis naked, endopod of two segments, exopod of one

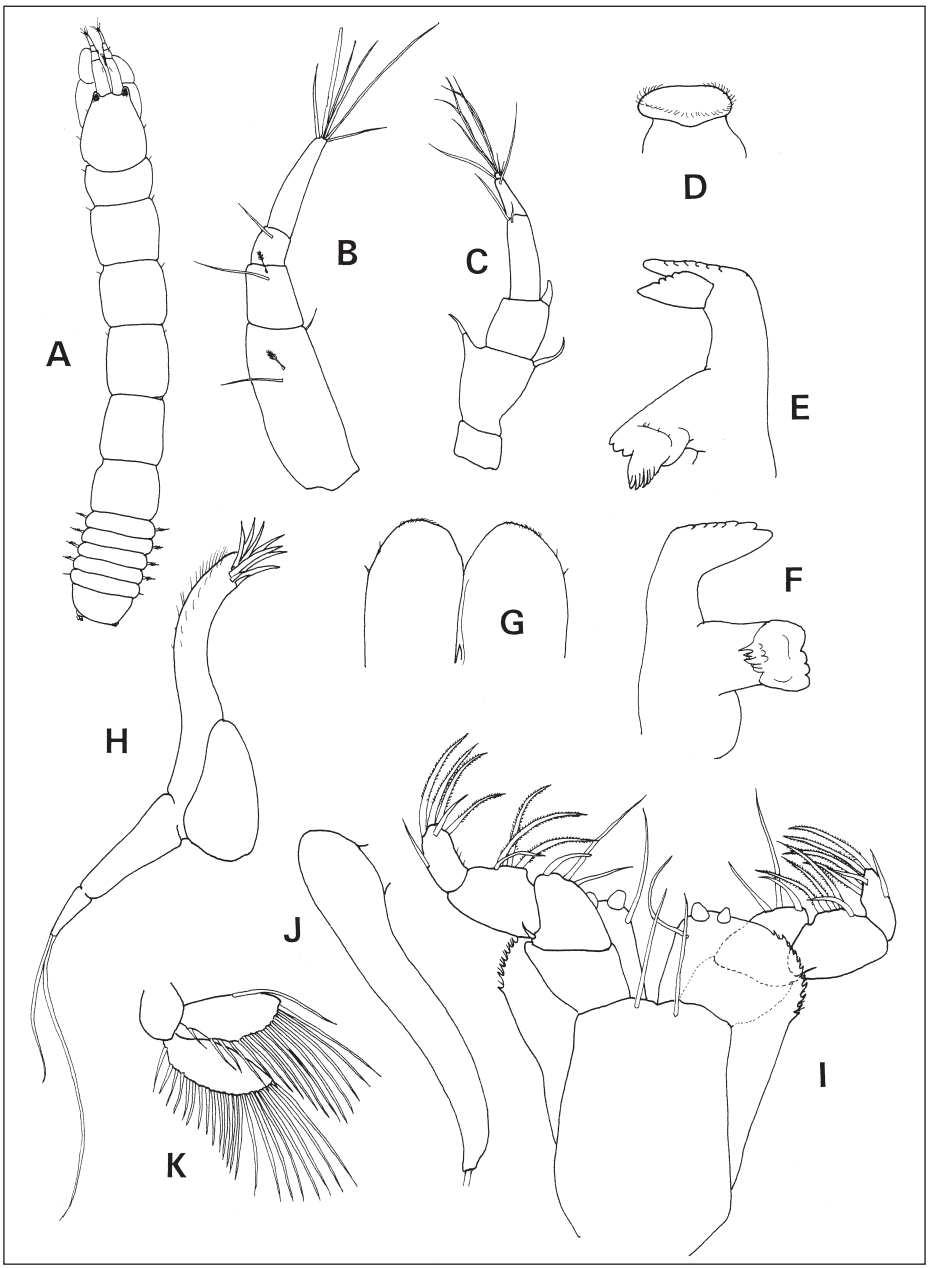

FIGURE 4. *Paratanais martinsi* sp. nov., A, holotype, dorsal; B, antennule; C, antenna; D, labrum; E, left mandible; F, right mandible; G, labium; H, maxillule and maxilla; I, maxilliped; J, epignath: K, pleopod (plumose nature of all setae not shown). Scale line = 1 mm for A, 0.2 mm for B and C, 0.1 for D to J.

segment, shorter than proximal segment of endopod.

Male unknown.

Etymology: named after António de Frias Martins, in gratitude for his assistance in attending the workshop, and exemplary hospitality.

Remarks: the genus *Paratanais* has been capably diagnosed by Lang (1973). The only species from the North Atlantic attributed previously to *Paratanais* are all *incertae sedis*. Bate & Westwood (1868) described "*Paratanais*" *rigidus* from one specimen collected from *Laminaria* holdfasts off Glasgow, western Scotland: while their four-articled antennule is appropriate, they carefully describe the uropod rami as both being of one segment, and an elongate, slender chela; their species is not a member of the genus *Paratanais*, but with the inadequate description and figures must remain *incertae sedis*. *P. limicola*

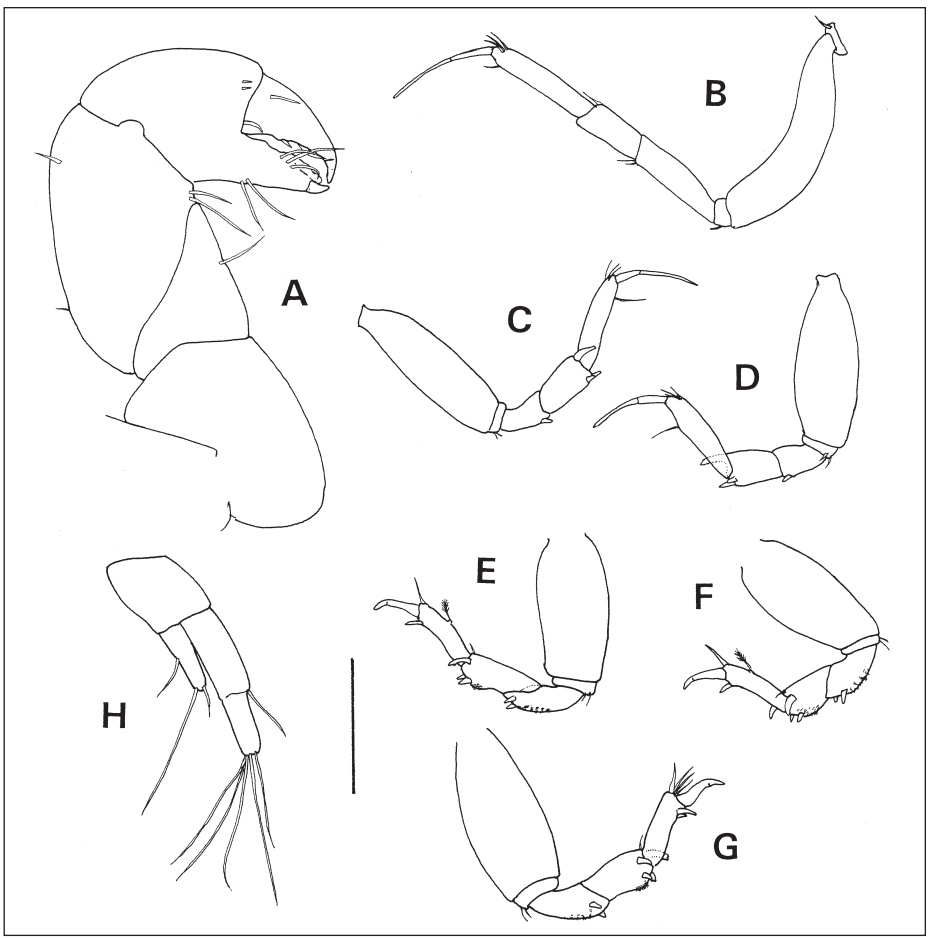

FIGURE 5. *Paratanais martinsi* sp. nov., A, cheliped; B to G, pereopods 1 to 6 respectively; H, uropod. Scale line = 0.2 mm for A to G, 0.15 mm for H.

Harger, 1878 (see Harger, 1880, for description and figures) has a three-articled antennule, and the uropod has two segments in the exopod and five in the endopod: Harger himself (1880) moved this species, apparently correctly, to *Leptochelia*. Dollfus (1897) described "*Paratanais*" *atlanticus* from 130 m depth off the Azores, based on a male and two females; although the description is somewhat cursory, and the figures inadequate, his species clearly had a three-articled antennule in the female, and the uropod had a two-segmented exopod and a three-segmented endopod; Dollfus' species thus cannot be a member of the genus *Paratanais*. Finally, Monod (1925) suspected a specimen from 110 m depth off Morocco to be *P. euelpis* Barnard, 1920 (a species adequately refigured by Lang, 1973), but without full confidence (and without description or figure). It is possible that his specimen, if indeed of this genus, was of the present species.

In having the setose apophyses on the second article of the antenna, more characteristic of species of *Leptochelia*, *Paratanais martinsi* sp. nov. is similar only to *P. gaspodei* Bamber, 2005, with which it also shares the elongate, slender uropod segments, and the short chela. The present species differs from *P. gaspodei* in a number of characters, including being generally more slender (pleonites 3, 4 and 5 as long as or longer than wide, all wider than long in *P. gaspodei*), with more slender articles in the antennule and antenna (proximal peduncle article of antennule less than twice as long as wide in *P. gaspodei*), in the inner spines on the maxilliped basis exceeding the distal margin of the endites (not reaching the margin in *P. gaspodei*), and with the merus of pereopod 1 being 1.5 times as long as the carpus (subequal in length in *P. gaspodei*). With regard to the possible Moroccan record of Monod (1925), *P. euelpis* also has a shorter merus to pereopod 1, and is without the apophyses on the second article of the antenna, as well as differences in mouthpart setation.

TENERIFE MATERIAL

Superfamily Tanaoidea Dana, 1849
Family Tanaidae Dana, 1849
Subfamily Pancolinae Sieg, 1980
Genus *Zeuxo* Templeton, 1840
Zeuxo (Parazeuxo) exsargasso Sieg, 1980
Figure 6 C, D

Zeuxo (Parazeuxo) exsargasso Sieg, 1980, 217-221, figure 61.

Material: 3 males, 3 females with oostegites, 1 brooding female (NHM.2007.757-763), 1 female with oostegites (dissected), rocky intertidal platform covered in algal turf, Playa de Fanabe, Costa Adeje, Tenerife, 27 June 2007. Coll. B Morton.

Remarks: *Zeuxo exsargasso* was only known from the type collection from floating *Sargassum natans*, 20 miles southeast of Bermuda (Sieg, 1980). Its presence in the Canary Islands implies the possibility of transport by drift from America via the Gulf Stream and the Azores and Canary Currents. The only other recorded species of *Zeuxo* in north-eastern Atlantic waters is the only-distantly-related *Zeuxo (Zeuxo) holdichi* Bamber, 1990, known from the Atlantic shores of France and Portugal and the English Channel (Bamber, 1990; & unpubl. data). *Zeuxo* species are distinguished from *Tanais* species in their having five dorsally-demarcated pleonites (*Tanais* has only four), and no dorsal rows of plumose setae on the pleon (*Tanais* has conspicuous rows on pleonites 1 and 2); the uropod of *Z. exsargasso* has five segments (Figure 6D).

DISCUSSION

There are now five species of shallow-water tanaidacean recorded from the Azores, *Tanais grimaldii*, *Leptochelia savignyi sensu stricto*, *Leptochelia caldera*, *Paratanais martinsi* and the unconfirmed *Leptognathia* from Ponta da Ferraria.

The present data demonstrate that Azorean tanaidacean fauna inhabits littoral to infralittoral algae, is generally sparse, but may show a relatively high degree of endemism. For the only species occurring in the 1996 and 1997 data in sufficient numbers for interpretation, *Tanais grimaldii*, no trends were detected in relation to disturbance or exposure.

Unfortunately, these taxa give little information on the origins of the Azorean fauna. The *Leptognathia* specimen tells nothing. The two species described as new above are as yet unknown from elsewhere: *Leptochelia* is a worldwide genus, while *Paratanais* is predominantly southern hemisphere in distribution (Australia, Subantarctica, South Africa) but also found in the Indo-West Pacific, the Kurile Islands and California.

T. grimaldii has been recorded from the Mediterranean (Adriatic) by Sars (1886, as *T. cavolinii*), his figure clearly showing the appropriate uropod structure. Sieg (1980) attributes the record of *T. chevreuxi* from the Moroccan coast by Monod (1925) to *T. grimaldii*, but regards it as doubtful, as he did the record from the Bay of Naples by Smith (1906); neither author gives a description or figure, and the decision of Sieg (loc. cit.) is based on their attributing the authority for their name to Sars, 1886. Both of these records are surely *incertae sedis*. There are no pub-

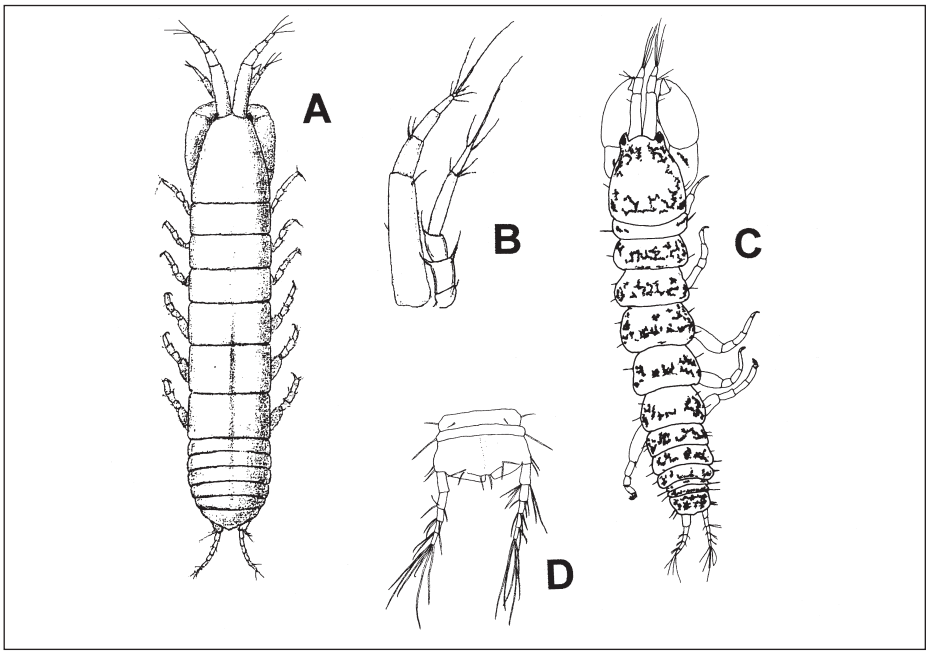

FIGURE 6. A and B, *Leptochelia savignyi*: A, dorsal; B, antennule (redrawn after Sars, 1886). C and D, *Zeuxo (Parazeuxo) exsargasso* (Tenerife specimen): A, dorsal; B, pleotelson and uropods, dorsal.

lished records of *Tanais* species from the Canary Islands or from Madeira.

While there has been confusion over the years regarding *Leptochelia savignyi* (see above), the type locality is Madeira, and the only other valid records (other than those of Dollfus, 1897; 1898) are those of Sars (1886) from the Mediterranean, from the Ligurian Sea and off Sicily.

Thus there are a few indications that the Azorean tanaidacean fauna may have links with the Mediterranean, but not elsewhere. Morton & Britton (2000) found that most components of the Azorean marine fauna show affiliation with the Mediterranean and southern Europe. However, the discovery of *Zeuxo exsargasso* in Tenerife strongly implies colonization from the western Atlantic to Macaronesia via the Gulf Stream, the Azores Current and the Canary Current (see Timmermann, 1932, for a discussion on faunistic transport in *Sargassum*).

It is undoubtedly the case that the tanaidacean fauna of Macaronesia is very understudied, and that of the Mediterranean and Atlantic coasts of Europe and North Africa is little better known, still relying heavily on 19th century information. At the same time the speciation of such taxa as *Leptochelia* around the North-east Atlantic and Mediterranean needs proper study.

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