EGYPTIAN INTERSTITIAL COPEPODA HARPACTICOIDA WITH THE DESCRIPTION OF TWO NEW SPECIES AND ONE NEW SUBSPECIES

BY

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ABSTRACT

Nine species of Copepoda Harpacticoida were found in sandy beaches in Egypt during the period November 1994 to December 1996. Two species of the family Ectinosomatidae are new to science, *Arenosetella bassantae* n. sp. and *Noodtiella toukae* n. sp. The genus *Noodtiella* is new to the fauna of the Mediterranean Sea. One subspecies of the family Paramesochridae is new to science, *Kliopsyllus constrictus egyptus* n. subsp. The other species found are already known from the Mediterranean: *Arenopontia nesaie* (Cylindropsyllidae), *Phyllopodopsyllus pauli* (Tetragonicipitidae), *Amphiascus parvus* (Diosaccidae) and *Nitocra spinipes* (Ameiridae). The last two species (*A. parvus* and *N. spinipes*) have already been recorded from Egyptian waters. This paper contains descriptions of the two new species and of local variations in one of the known species, *Arenopontia nesaie* and the new subspecies *Kliopsyllus constrictus egyptus*. Two more species could as yet not be identified beyond generic level: *Alteutha* sp. (family Peltidiidae), and *Amphiascus* sp.

RÉSUMÉ

Neuf espèces de copépodes harpacticoïdes on été trouvées dans les plages sableuses, en Égypte, durant la période de novembre 1994 à décembre 1996. Deux espèces de la famille des Ectinosomatidae sont nouvelles pour la science, *Arenosetella bassantae* n. sp. et *Noodtiella toukae* n. sp. Le genre *Noodtiella* est nouveau pour la faune de la mer Méditerranée. Une sous-espèce de la famille des Paramesochridae est nouvelle pour la science, *Kliopsyllus constrictus egyptus* n. subsp. Les autres espèces trouvées sont déjà connues de Méditerranée: *Arenopontia nesaie* (Cylindropsyllidae), *Phyllopodopsyllus pauli* (Tetragonocipitidae), *Amphiascus parvus* (Diosaccidae) and *Nitocra spinipes* (Ameiridae). Les deux dernières espèces (*A. parvus* et *N. spinipes*) ont déjà été citées des eaux égyptiennes. Cet article contient les descriptions des deux espèces nouvelles et des variations locales de l'une des espèces connues, *Arenopontia nesaie*, ainsi que de la nouvelle sous-espèce *Kliopsyllus constrictus egyptus*. Deux espèces supplémentaires n'ont pas pu être identifiées au-delà du niveau générique: *Alteutha* sp. (Peltidiidae) et *Amphiascus* sp.

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INTRODUCTION

During this century, four taxonomic surveys of Copepoda Harpacticoida have been undertaken with regard to the marine fauna of Egyptian waters. Gurney (1927) reported on samples from the Suez Canal, Steuer (1943) studied the fauna of Alexandria, Nicholls (1944) described harpacticoids from El Ghardaqa, and Noodt (1964) studied samples from the Egyptian Red Sea coast. Gurney (1927) recorded 64 species belonging to 12 families, amongst which *Nitocra spinipes* Boeck, 1864, from the Suez Canal area. Steuer (1943) found four species and three subspecies belonging to the genera *Ameira* and *Mesochra* in material from Alexandria. Nicholls (1944) recorded 14 species from El Ghardaqa, Red Sea, belonging to seven families. None of Steuer's (1943) and Nicholls' (1944) species, however, are recorded in the present study. Noodt (1964) recorded 20 species belonging to five families and 11 genera from the Red Sea. Seventeen species were found on coral reefs and three were recorded from macroalgal habitats. *Amphiascus parvus* G. O. Sars, 1906 was recorded from Noodt's (1964) samples.

During the current ecological studies of the meiofauna along three sandy beaches of Alexandria, Egypt (November 1994 to December 1996), the harpacticoid copepods were sorted and identified to species level. Two dominant, new species (Ectinosomatidae) were found at three beaches. Taxonomic descriptions of the two new species, *Arenosetella bassantae* n. sp. and *Noodtiella toukae* n. sp., and the setation of all species described world-wide in those two genera is presented herein for comparative purposes. A short re-description is given for *Arenopontia nesaie* Cottarelli, 1975. A description of a new subspecies, *Kliopsyllus constrictus egyptus* n. subsp. is given, illustrating the difference in setation of the appendages between it and *Kliopsyllus constrictus pacificus* Mieke, 1984, which it closely resembles. The other species identified, *Nitocra spinipes* Boeck, 1864, *Amphiascus parvus* G. O. Sars, 1906, and *Phyllopodopsyllus pauli* Crisafi, 1959, are well known from Egyptian waters and from the Mediterranean Sea in general. Moreover, they were found to be rare near Alexandria, and also without any obvious variability in comparison with the original description. Hence, these species are not further described herein.

MATERIALS AND METHODS

Sampling was conducted at three sandy beaches along the coast at Alexandria. Two beaches, El Mamoura (1) and Bir Masoud (2), are located east of the city about 5 km apart, and one, El Shatby (3), is mid-city at a distance about 15 km from no. 1 (fig. 1). Holotypes and paratypes were dissected in lactic acid.

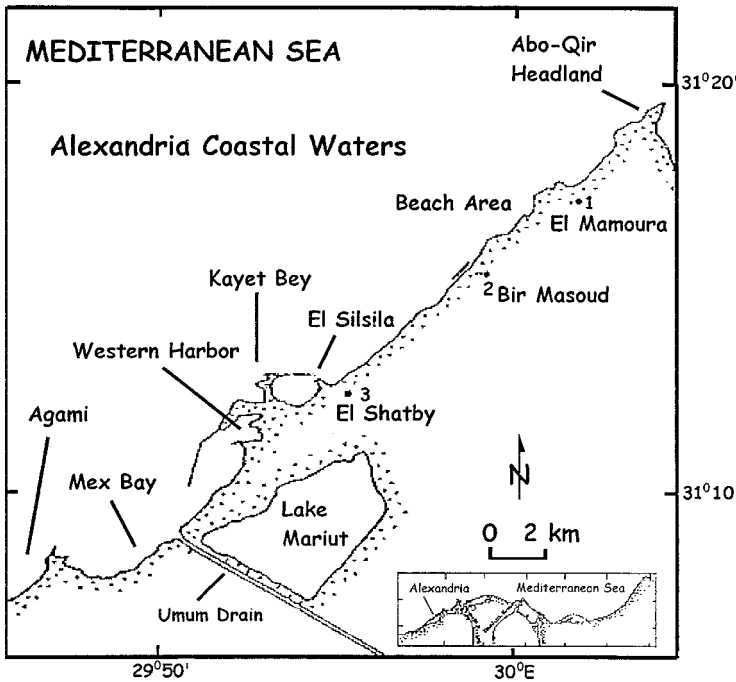

Fig. 1. Map, showing the study area.

The dissected appendages of the two new species were mounted in polyvinyl-lactophenol. Preparations were sealed with epoxy resin. Not mounted paratypes were preserved in 70% ethanol with glycerol. The dissected parts of the other re-described species were also mounted in polyvinyl-lactophenol. Some preparations were sealed with Bioseal and others with nail polish All drawings have been prepared using a drawing tube attached to a Zeiss phase-contrast compound microscope. The descriptive terminology is predominantly adopted from Wells & Rao (1987) and Huys et al. (1996). The following abbreviations are used throughout the text: R, rostrum; A1, antennule; A2, antenna; Md, mandible; Mxl, maxillule; Mx, maxilla; Mxp, maxilliped; P1-P6, first to sixth thoracopods; Exp., exopod; End., endopod. Body length measurements have been made from the anterior margin of the R to the posterior margin of the caudal rami. The type series of the new species and subspecies have been deposited in the collections of the Zoology Department, The Natural History Museum, London [BM(NH)].

TAXONOMIC ACCOUNT

Family ECTINOSOMATIDAE G. O. Sars, 1903

Genus *Noodtiella* Wells, 1965

Noodtiella toukae n. sp. (figs. 2-5)

Material examined. — 20 ♀♀, 10 ♂♂. Holotype: ♀ [BM(NH) 1999.1247], and allotype: ♂ [BM(NH) 1999.1248]. Paratypes: 10 ♀♀, dissected, and 7 ♂♂, dissected.

Type locality. — The holotype was collected at the sandy beach El Mamoura at Alexandria, Egypt.

Description. — Female (fig. 2A, B); based on non-ovigerous holotype ♀. Total body length 305 μm. Paratypes range from 305 to 336 μm ($N = 20$; $\bar{x} = 320$; $s = \pm 20.19$), measured from the anterior margin of the rostrum to the posterior margin of the caudal rami. Largest width 44 μm, measured at posterior margin of cephalothorax.

Body vermiform, cylindrical, without clear demarcation between prosome and urosome. Cephalic shield and body somites lightly pitted and only slightly chitinized, and with a striated, palisaded hyaline frill at the posterior margins. Cephalothorax with a few scattered sensilla (not clearly obvious in many of the specimens investigated). On the caudal edges of each abdominal somite there are bundles of spines, projecting upward. Anal somite with a pair of dorsal lamellae, clearly showing a two-layered structure; lower layer entire and smooth, upper layer multidentate. On the ventral side of the anal somite there is a transverse row of seven triangular spines near the anterior margin. The two upper, multidentate parts of the lamellae are widely separated. There is a group of three spines at each lateral edge of the anal somite. Caudal rami sub-rectangular, the ventral side equipped with a transverse row of fine setules. There are five ramal setae: a small anterolateral accessory seta, an anterolateral seta, an outer terminal seta, an inner terminal seta, and a terminal accessory seta. The inner terminal seta is the principal seta. This seta is very long, slightly swollen proximally, and divergent distally, being directed outwards. The outer terminal seta is slender and half as long as the principal seta. The terminal accessory seta is short and located on the inner subterminal corner.

R (fig. 3A), triangular, not clearly distinct at the base, recurved ventrally in lateral view.

A1 (fig. 3A), 6-segmented, short, segments compressed except the terminal one. The distinction between segments 3 to 5 is weak, giving an appearance of 5 segments in total only. One aesthetasc arises from the base of segment 3 and another one is fused basally to two slender setae on segment 6. All setae are bare and slender.

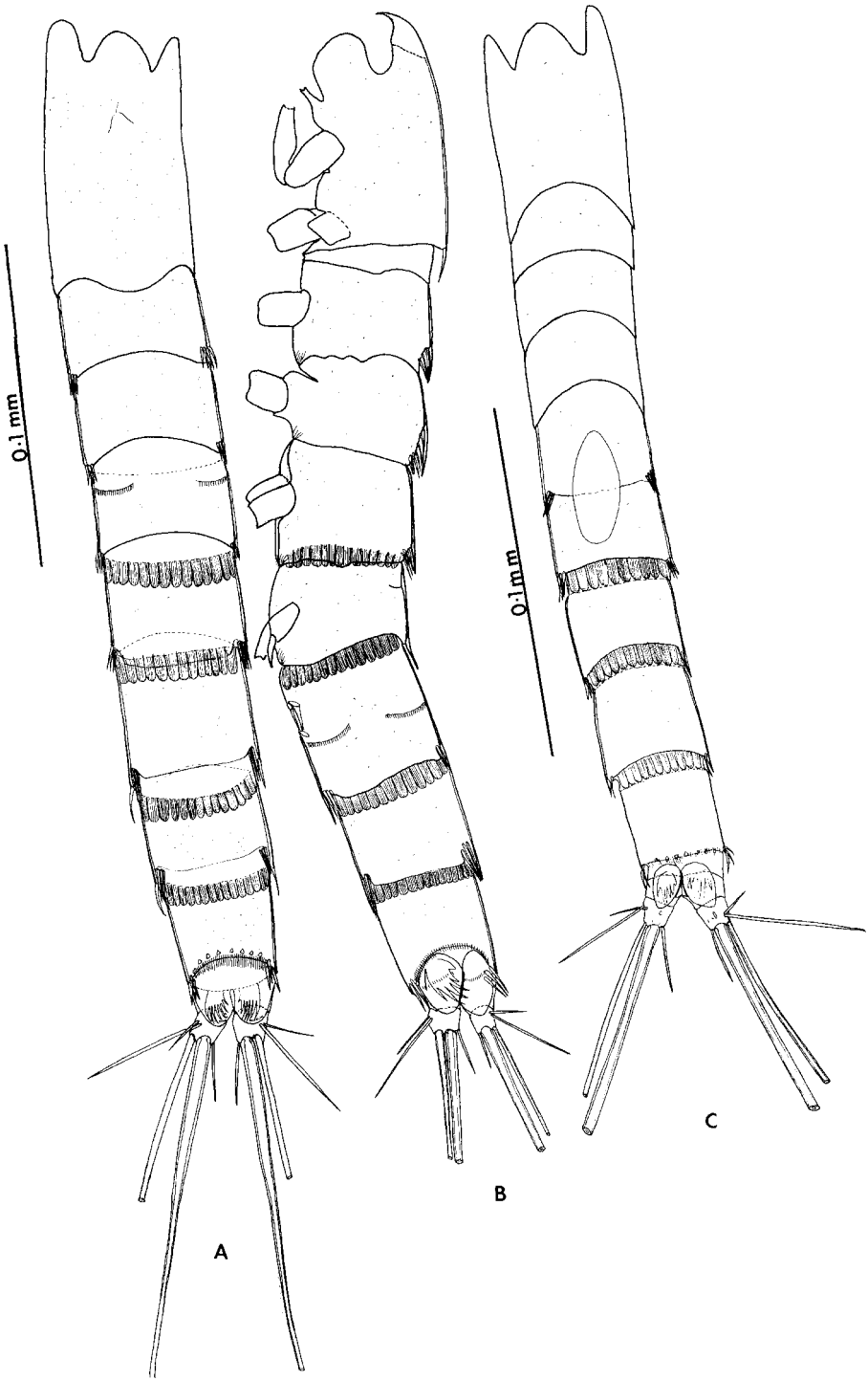

Fig. 2. *Noodtiella toukae* n. sp. A, ♀ dorsal; B, ♀ lateral; C, ♂ lateral.

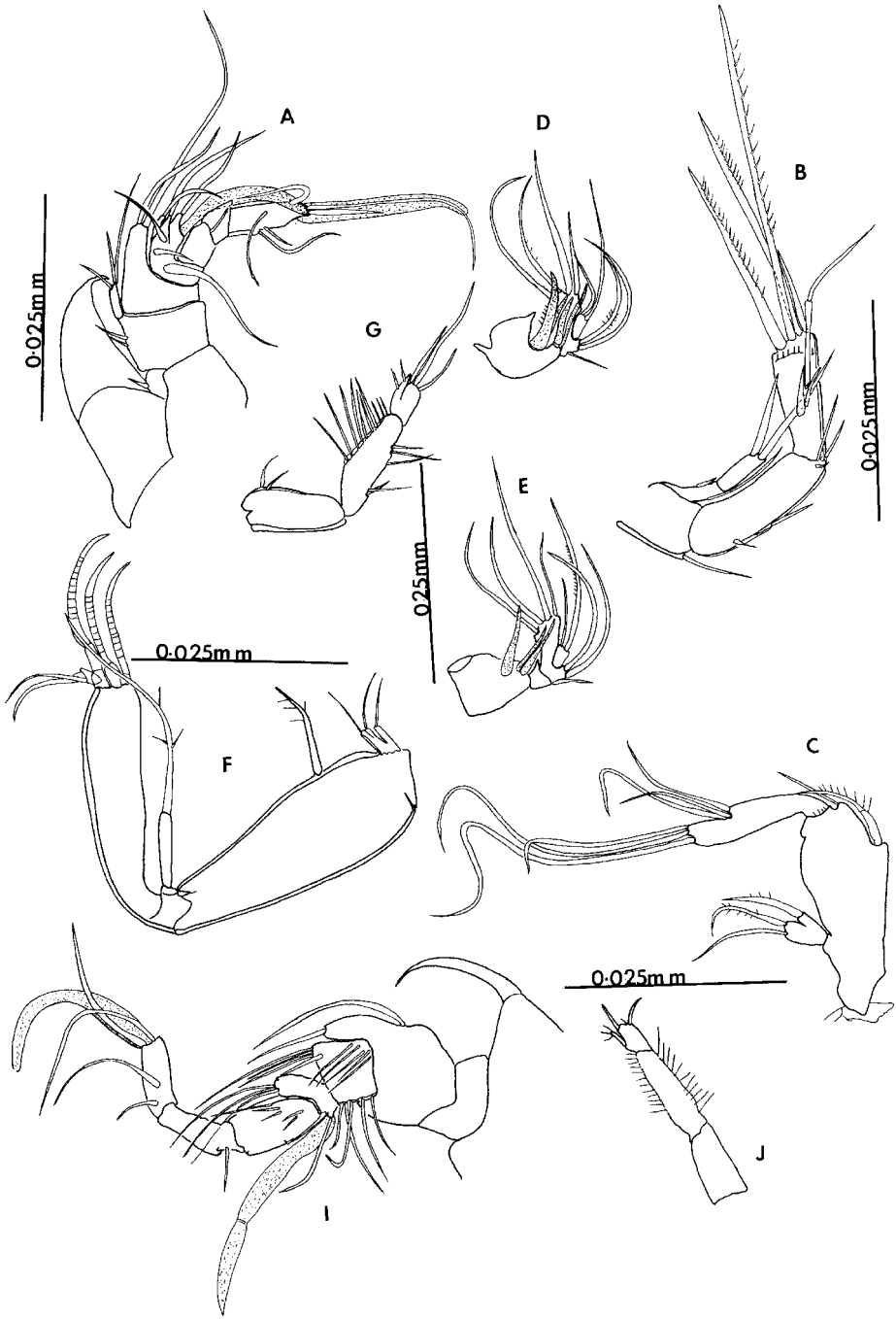

Fig. 3. *Noodtiella toukae* n. sp. A, ♀ A1 and R; B, ♀ A2; C, ♀ Md; D-E, ♀ Mxl; F, ♀ Mx; G, ♀ Mxp; I, ♂ A1 and R; J, ♂ Mxp.

A2 (fig. 3B), coxa not observed. Basis rectangular with two small spines on the outer distal part. Exopod 2-segmented, with one and two setae, respectively. The distal segment bearing four long, geniculate terminal setae and two subterminal setae.

Md (fig. 3C), coxa not observed. Basis with two setae; one bare, slender, the other slightly thicker, bearing setules. Exopod one-segmented with three plumose setae. Endopod one-segmented with three lateral and three terminal setae.

Mxl (fig. 3D, E), with pre-coxal arthrite with four setae, one obscured by the others, giving the appearance of three. Basis indistinctly separated from coxa, only marked from each other by two long setae. Exopod and endopod with two and four setae, respectively. Exopod difficult to distinguish from endopod.

Mx (fig. 3F), very large and robust. Syncoxa elongate; it appears to have one branched endite and one seta at the inner proximal corner, but these structures are difficult to discern. A long seta arises from the inner distal corner of the syncoxa. This seta has a swollen base and is otherwise tapering, with setules at its distal edge. This seta probably represents the rudiment of another endite (Wells & Rao, 1987). Basis elongate and prehensile, situated on the outer distal part of the syncoxa. Exopod without trace of segmentation but represented by three short, geniculate setae and two slender, bare setae.

Mxp (fig. 3G). The 3-segmented maxilliped is non-prehensile, slender, and narrow (stenopodial type). Proximal segment with two outer setae. The inner and outer edges of the middle segment with long, fine setules. Distal segment with five setae.

The setation of P1 to P4 is as follows:

	Exopod			Endopod	
	1	2	3	1	2
P1	0	1	022	1	121
P2	1	1	022	1	221
P3	1	1	022	1	221
P4	1	1	021	1	221

P1-P4 (figs. 4A, C, 5A). Coxa elongate, broad; basis small. The margin of coxa and basis is marked by a striated, oblique, palisaded hyaline frill. Endopods composed of two elongated segments, larger than the exopods. The proximal segments have a transverse row of spinules basally on their anterior surface. The distal segments have an indented, transverse row of spinules halfway along the length of the segment. The distal segment of P1 has long, very fine setules at the inner edge. The distal segments of P2 to P4 have a long seta arising from the posterior surface. Exopods all 3-segmented, the second segment with a conspicuous, long seta.

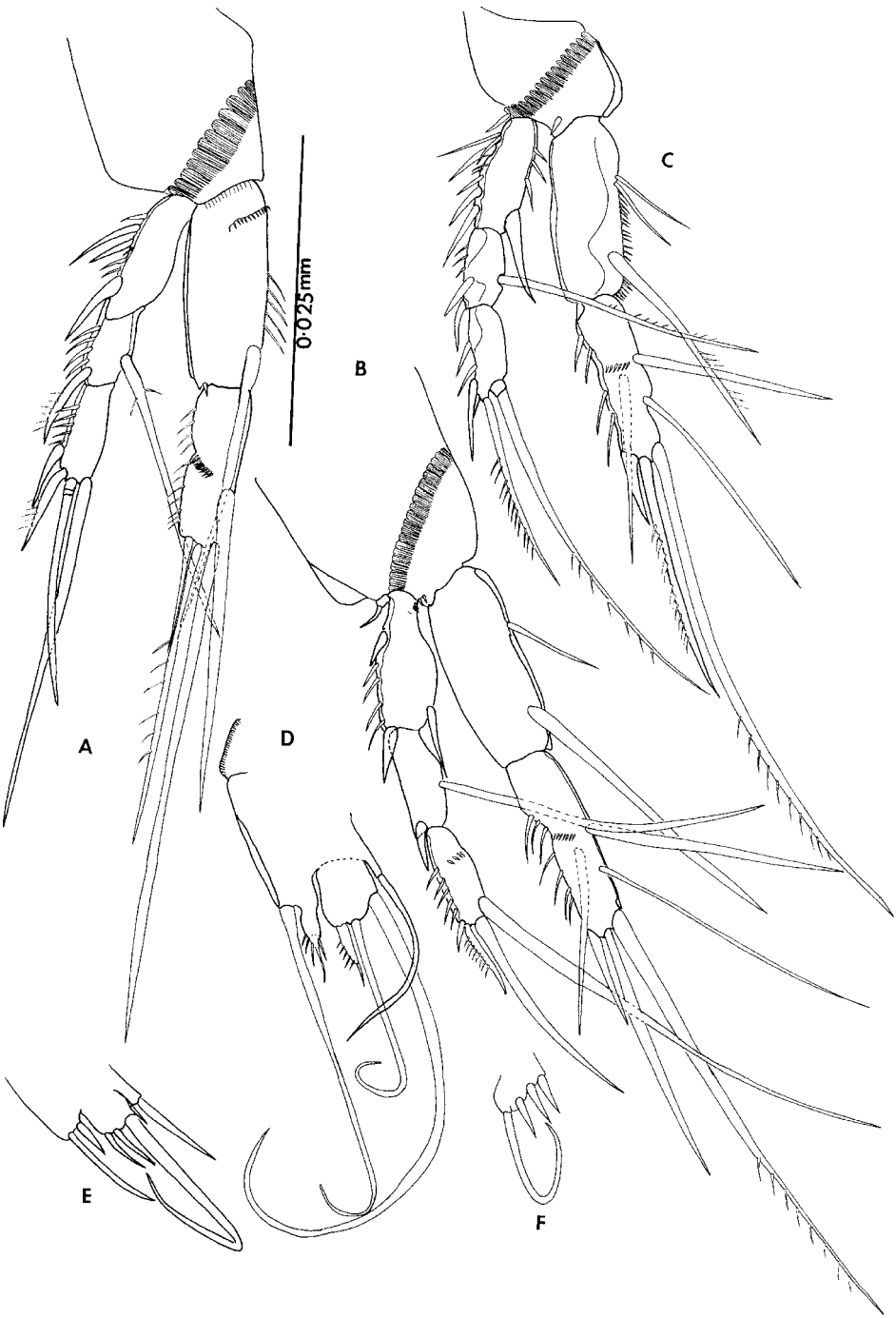

Fig. 4. *Noodtiella toukae* n. sp. A, ♀ P1; B, ♀ P2; C, ♀ P4; D, ♀ P5; E, ♂ P5; F, ♂ P6.

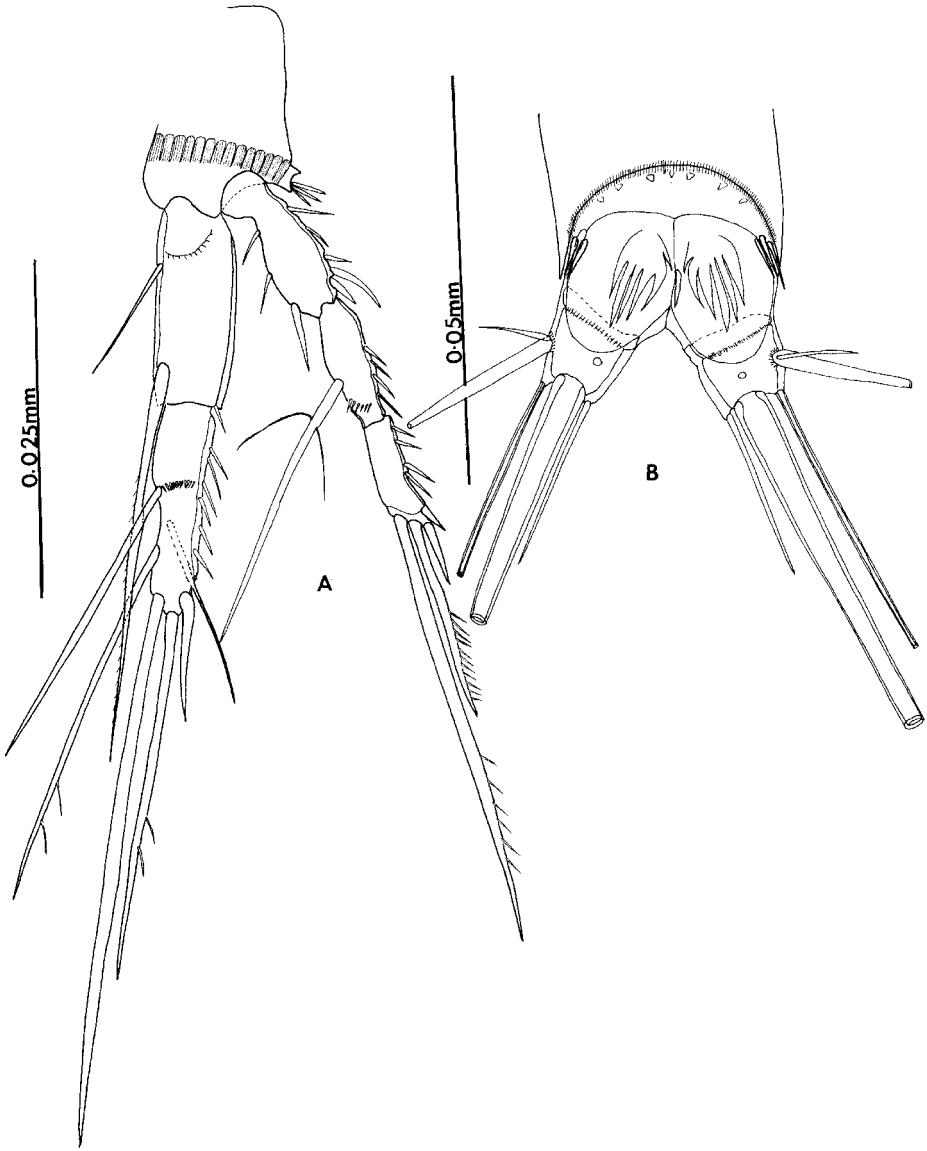

Fig. 5. *Noodtiella toukae* n. sp. A, ♀ P3; B, ♂ anal somite.

P5 (fig. 4D). Exopod one-segmented with three marginal setae: outer one very long and thick, others shorter and less robust. Exopod not clearly distinct from baseoendopod. The outer margin of baseoendopod with one long seta. Inner expansion of baseoendopod margin with two setae, outer one short, fused with baseoendopod, spiniform and plumose, inner seta long and bare.

Genital field (fig. 2B). Somites 6 and 7 fused ventrally, marked from each other by an incomplete, transverse row of chitinous setae. Genital field positioned in the anterior third of the genital double somite. Genital pore semicircular.

Male (figs. 2C, 5B); based on one adult ♂, 305 μm long (allotype), measured from anterior margin of rostrum to posterior margin of caudal rami. Paratype ♂♂ range from 286 to 305 μm ($N = 10$; $\bar{x} = 283.4$; $s = \pm 14.29$). Body smaller than that of female. Sexual dimorphism in A1, Mxp, P5, P6, somatic hyaline frill, and body segmentation.

A1 (fig. 3I), 6-segmented, the first segment large and swollen, the 4th to the 6th segments elongate. Two aesthetascs present, one on the base of the third segment, the other on the terminal segment. Demarcation between the 3rd and the 4th segment is indistinct, giving the appearance of 5 segments only.

Antennae, mandibles, maxillules, maxillae, and P1 to P4 are similar to those of the female.

Mxp (fig. 3J). Setules on female Mxp generally more robust than those on male appendage.

P5 (fig. 4E). Exopod and baseoendopod fused. Exopod with three setae, the outer very long and the two inner ones short. The outer and inner margins of the baseoendopod with two setae, the inner long and the outer short.

P6 (fig. 4F), well defined at the base, with one long outer seta and three short inner setae. The 6th and 7th abdominal somites are not fused as in the female. The palisaded, hyaline somatic frill is weak compared to that of the female.

Variability. — Variation in setation of the appendages of both female and male was not observed in any of the dissected paratypes. Some slight variations in the size of the transverse, palisaded hyaline frill between coxa and basis of P1 to P4 were observed in one dissected female, being narrower than in the other specimens. Another dissected paratype female had sharper chitinous spinules on the edge of each somite. One dissected male had a slightly shorter proximal segment in the endopod of P1.

Etymology. — The species is named for the senior author's daughter, Touka, whose name is derived from "obedience" in Arabic. The name *toukae* hence is a noun in the genitive singular.

Remarks. — *Noodtiella toukae* is characterized by the presence of a pair of multidentate lamellae on the anal somite. This strongly differentiated armature is a specific characteristic of the genus *Arenosetella* rather than of *Noodtiella*, but the specific shape of the maxillae and maxillipeds, the two-segmented endopods of P1 to P4, and the two-segmented exopod of A2, confirmed that this species belongs to the genus *Noodtiella.*

TABLE I

Differences between *Noodtiella ornamentalis* Wells & Rao, 1987 and *Noodtiella toukae* n. sp.

Character	*N. ornamentalis*	*N. toukae*
R	Triangular; well defined at base	Triangular; indistinct at base
A1	Six-segmented, with one aesthetasc	Six-segmented, with two aesthetascs
A2	Distal exopod segment with small accessory setae	Distal exopod segment without small accessory setae
Md	Distal endopod segment with 5 setae	Distal endopod segment with 6 setae
Mxp	Proximal segment without seta, outer edge bare without hairs or setules; distal segment with three setae	Proximal segment with two outer setae, both edges with setules and hairs; distal segment with five setae
P2-P4	Distal endopod segment without surface setae	Distal endopod segment with surface setae
P5	Exopod fused with endopod	Faint suture between rami
Hyaline frill	Plain palisaded, without bundles of chitinous spines on each abdominal somite	Striated palisaded, with bundles of chitinous spines on each abdominal somite
Gonopore	Elongate in shape	Semi-circular in shape
Caudal rami	Six ramal setae, length of two terminal ones not exceeding the length of the body	Five ramal setae, length of two terminal ones twice as long as body
Anal somite	Multidente lamellae divergent, without marked distinction	Multidente lamellae convergent, distinctly separated with thick edge

Among thirteen species of *Noodtiella* described world-wide (Huys et al., 1996), there are two species characterized by having a special feature on the anal segment: *Noodtiella frequentior* Mielke, 1979 (cf. Mielke, 1979, 1981) and *N. ornamentalis* Wells & Rao, 1987. *N. frequentior* was recorded from South America. It has some long, fine setules on the anal segment. The 2-segmented exopod of P4 and the different setation of of P1 to P3 indicate that the present species is not *N. frequentior*. *Noodtiella ornamentalis* was found in Calcutta, India. It has a pair of upraised, multidentate lamellae on the anal somite as has *Noodtiella toukae*. There are, however, a number of differences between these two animals that are listed in table I.

Comparison of the new species, *N. toukae*, with the remaining *Noodtiella* species, shows the following differences: the exopod of the P4 of both *N. mielkei* Wells & Rao, 1987, and *N. gracile* Mielke, 1975, has two segments. The setation of P1-P4 and the structure of P5 in *N. tabogensis* Mielke, 1981, are different from those in the new species, *N. toukae*. The setation of P1-P4 for all described species has been tabulated in table II. All tabulated differences between females of the

TABLE II
Setation formulae of females' natatory legs of species of *Noodtiella* Wells, 1965 (as revised by Kunz, 1974)

Species	P1		P2		P3		P4	
	Exp.	End.	Exp.	End.	Exp.	End.	Exp.	End.
N. toukae n. sp.	0.1.022	1.121	1.1.022	1.221	1.1.022	1.221	1.1.021	1.221
N. ornamentalis Wells & Rao, 1987	0.1.022	1.121	1.1.022	1.221	1.1.022	1.221	1.1.022	1.221
N. wellsi Apostolov, 1974	0.1.022	1.121	1.1.022	1.221	1.1.022	1.221	1.1.022	1.221
N. arenosetelloides (Noodt, 1958)	0.1.022	1.121	0.1.022	1.121	1.1.022	1.121	1.1.022	1.121
N. lusitanica Wells, 1965	0.1.022	1.121	0.1.021	1.221	0.1.021	1.221	0.1.021	1.221
N. hoodensis Mielke, 1979	0.1.022	1.120	1.1.021	1.220	1.1.021	1.220	1.1.021	1.220
N. tabogensis Mielke, 1981	0.1.022	1.120	1.1.021	1.220	1.1.021	1.220	1.0.021	1.220
N. problematica (Rouch, 1962)	0.1.022	1.120	0.1.021	1.120	0.1.021	1.121	0.1.021	1.121
N. mielkei Wells & Rao, 1987	0.1.022	1.120	1.1.022	1.121	1.1.022	1.121	1.122	1.120
N. frequentior Mielke, 1979	0.0.022	1.120	1.0.021	1.220	1.0.021	1.220	1.021	1.220
N. gracilis Mielke, 1975	0.1.021	1.120	1.1.021	1.121	1.1.021	1.121	1.121	1.120
N. pacifica Mielke, 1987	0.1.220	1.120	0.1.021	1.220	0.1.021	1.220	1.1.021	1.220
N. larinconadensis Mielke, 1987	0.1.220	0.120	1.1.021	1.220	1.1.021	1.220	0.1.021	1.220
N. coquimbensis Mielke, 1987	0.1.021	1.120	1.1.021	1.121	1.1.021	1.121	1.121	1.121

various species of *Nitocra* and female *N. toukae* confirm that the latter is different from the others, and thus represents a new species.

At the three beaches sampled, El Mamoura, El Shatby, and Bir Masoud, the new species comprised 13%, 8%, and 6%, respectively, of the total population of harpacticoids.

Genus *Arenosetella* Wilson, 1932

Arenosetella bassantae n. sp. (figs. 6-10)

Material examined. — 30 ♀♀, 15 ♂♂. Holotype: ♀ [BM(NH) 1999.1236], and allotype: ♂ [BM(NH) 1999.1237]. Paratypes: 25 ♀♀, dissected, and 10 ♂♂, dissected.

Type locality. — The holotype was collected at the sandy beach El Shatby at Alexandria, Egypt.

Description. — Female (fig. 6A, B); based on non-ovigerous holotype ♀. Total body length 351 μm. Paratypes range from 336 μm to 378 μm ($N = 30$; $\bar{x} = 353.2$ μm; $s = 14.06$) measured from the anterior margin of the rostrum to the posterior margin of the caudal rami.

Body vermiform, cylindrical, without clear demarcation between prosome and urosome. Cephalic shield and body somites chitinized and with a striated, palisaded hyaline frill. The shape of the hyaline frill changes from semi-rounded edges to pointed to sharply pointed, respectively, from cephalic shield to urosome. Anal somite furnished with a pair of closed bifid, spiniform processes, giving the appearance of four spines rather than claw-like structures, on mid-dorsal surface (fig. 6C). Caudal rami as long as wide, with five ramal setae, a small anterolateral accessory seta, broken on one side, a long, slender anterolateral seta, an outer terminal seta, an inner terminal seta (the principal seta), and a terminal accessory seta. The principal seta is approximately 81% of the total body length and twice as long as the outer setae.

R (fig. 7A), subtriangular, clearly distinct at base. Recurved ventrally in lateral view.

A1 (fig. 7A), 6-segmented. The 1st segment with one thick seta on the inner distal corner; 2nd segment short, compressed, indistinctly separated from the 3rd segment, thus appearing as one segment. A long aesthetasc arises from the 3rd segment. The other three segments are rectangular in shape. The 6th segment terminates in another aesthetasc and a very thin seta.

A2 (fig. 7B), coxa barely distinct. Basis as wide as long with one small seta on the distal edge. Exopod 3-segmented and longer than 1st endopod segment. First segment with two setae on distal corner. Second segment with two setae on distal corner and one on proximal corner. The 3rd segment with two terminal setae. Endopod 2-segmented, the 1st segment longer than the 2nd and without spinules or spines. Second segment thickened distally, with two plumose spines on middle of anterior edge and one bare seta near proximal edge. Five plumose setae and three bare setae occur on the distal end.

Md (fig. 7C), precoxa not observed. Coxa-basis remarkably widened distally with three setae, one plumose, and two bare. Exopod represented by a small, rounded segment with three terminal setae (two bare and one plumose). Outer margin of the exopod covered by many setules. Endopod oval in shape with four bare terminal setae, three setae on the outer edge, and two on the inner edge.

Mxl (fig. 7D), pre-coxal arthrite with four setae: one bare, one plumose; the other two branched and forming two and four setae, respectively. Endopod with two lateral and four terminal setae. The exopod is a small, square segment with four thick setae.

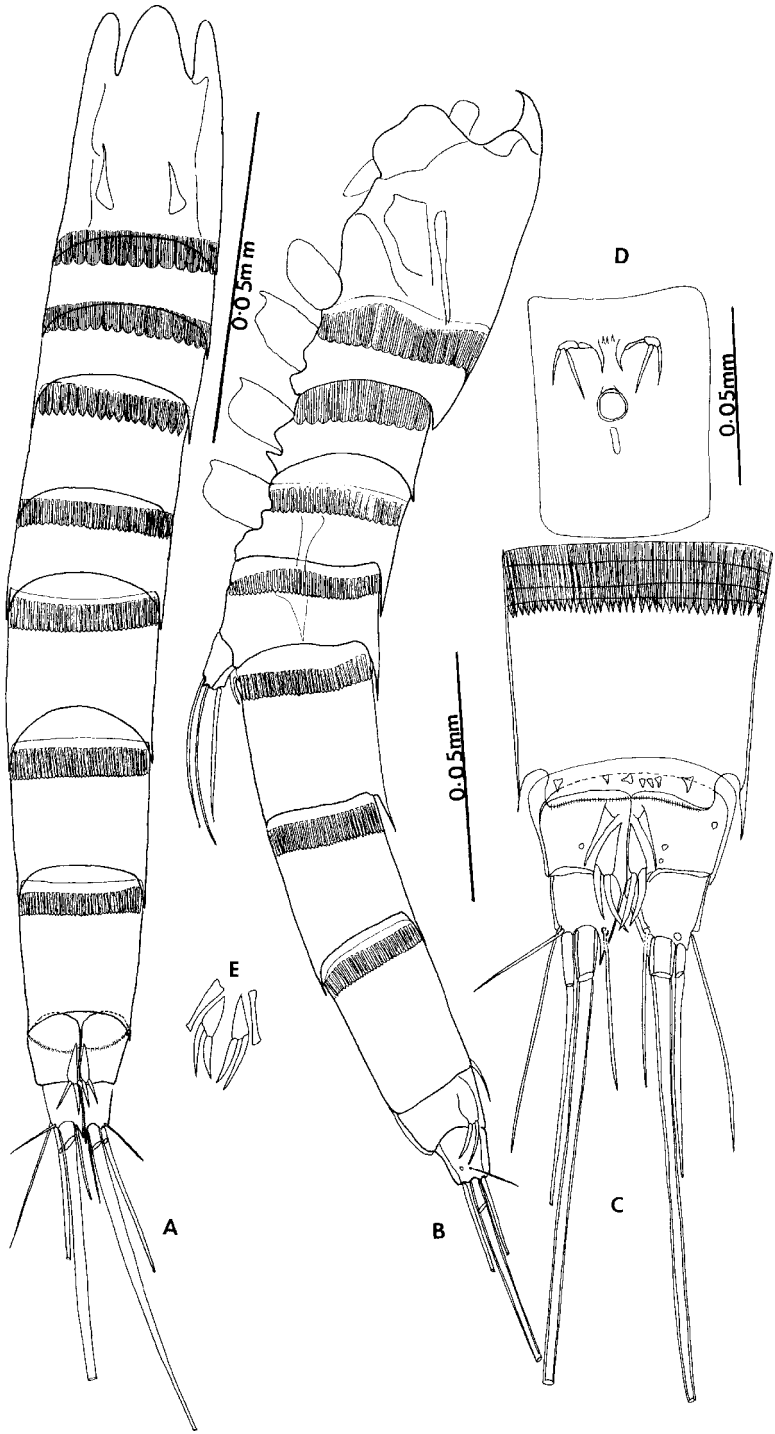

Fig. 6. *Arenosetella bassantae* n. sp. A, ♀ dorsal; B, ♀ lateral; C, ♀ anal somite; D, ♀ genital field; E, closed spiniform processes.

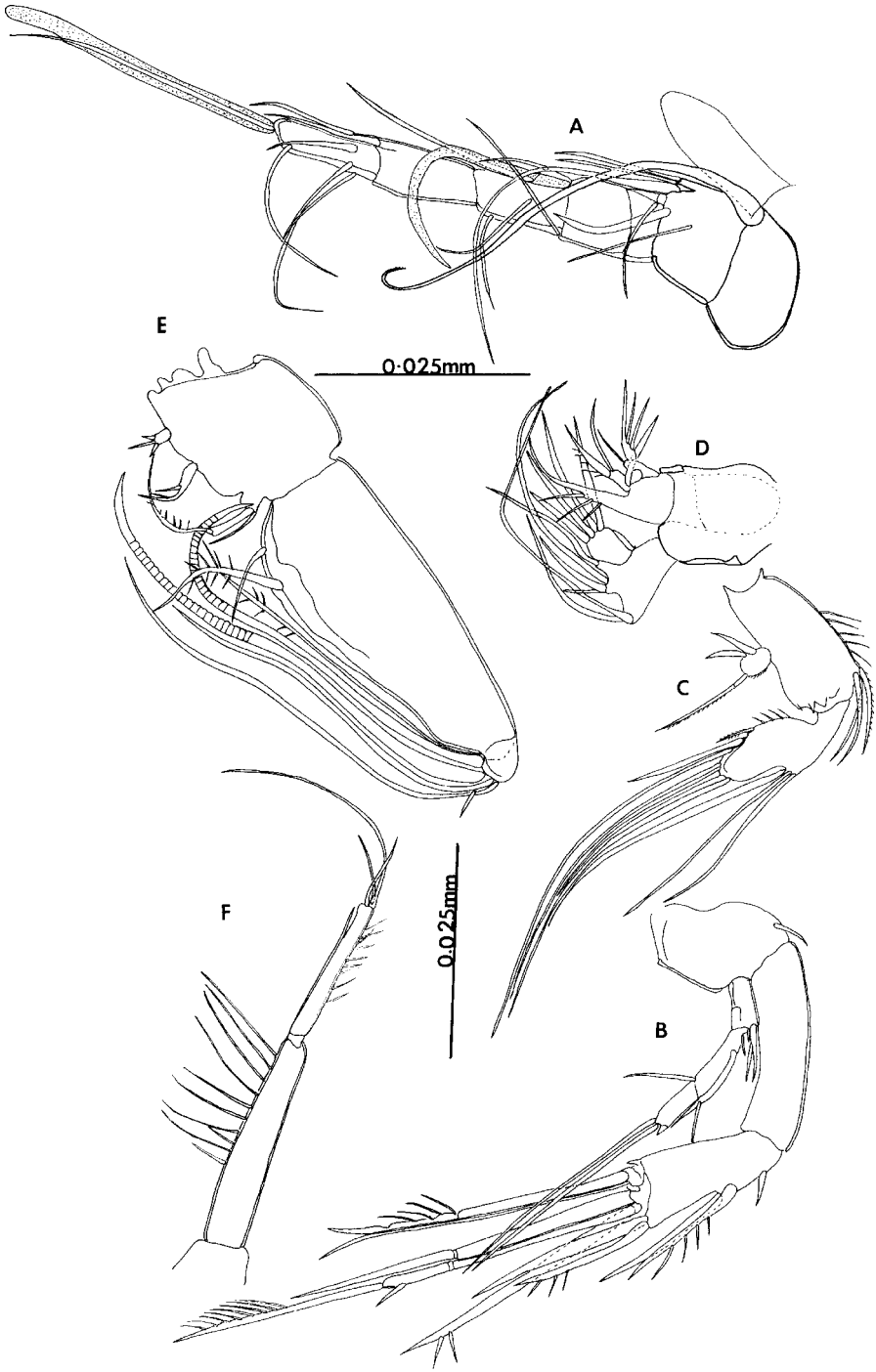

Fig. 7. *Arenosetella bassantae* n. sp. A, ♀ A1 and R; B, ♀ A2; C, ♀ Md; D, Mxl; E, ♀ Mx; F, ♀ Mxp.

Mx (fig. 7E), syncoxa about as long as wide with three endites. Two endites on the outer margin, with three and two bare setae, respectively. The 3rd endite on the inner margin with two subsurface, bare setae and two terminal, one bare and one plumose. Basis more than twice as long as syncoxa, widened proximally and tapering distally. Outer margin convex, inner proximal edge with two setae. Endopod represented by two geniculate, one plumose, and two slender bare setae.

Mxp (fig. 7F), coxa incomplete. Basis about 4.5 times as long as greatest width. Distal two-thirds of inner margin flanked with setules. Endopod slightly shorter than the basis, tapering slightly toward distal end, terminated by two short setae and one long, slender seta. Inner edge with a long seta, but difficult to discern in the preparations examined.

P1 (fig. 8A), coxa broad, as long as wide, and basis small. Demarcation of coxa-basis margin is very indistinct. Basis furnished with one thick, plumose seta arising from anterior side. Exopod and endopod 3-segmented. Exopod about as long as first two endopod segments combined. Proximal exopod segment without inner seta, middle segment with a very long inner seta, bifurcated apically, and distal segment with five setae. The proximal endopod segment has a transverse row of spinules on the surface, and one long plumose seta. The middle segment has two setae: a short one arising from the surface and one lateral plumose setae. The distal segment has five setae: one long seta on the inner edge, bifurcated apically, two plumose terminal setae, and two short bare setae on the outer edge.

The outer margin of all exopods (P1 to P4) is characterized by having very strong setules. The setation of P1 to P4 is as follows:

	Exopod			Endopod		
	1	2	3	1	2	3
P1	0	1	122	1	2	122
P2	0	1	122	1	2	121
P3	0	1	122	1	2	121
P4	0	1	122	1	2	122

P2 (fig. 9A), coxa broad with a thick seta; basis small, basal seta not observed. Exopod and endopod 3-segmented. Exopod similar to P1. Proximal segment of the endopod without a transverse row of spinules. Middle segment with two setae: one on surface and one lateral (shorter than that of P1). The distal segment with four setae: one long on inner edge, two terminal, and one on the outer edge.

P3 (fig. 10A), coxa and basis not observed. P3 is drawn from another paratype specimen. This specimen was investigated in conjunction with the holotype. The setation of both exopod and endopod is similar to P2 except for the structure of the lateral seta of the middle exopod segment, which tapers to the end instead of being bifurcated.

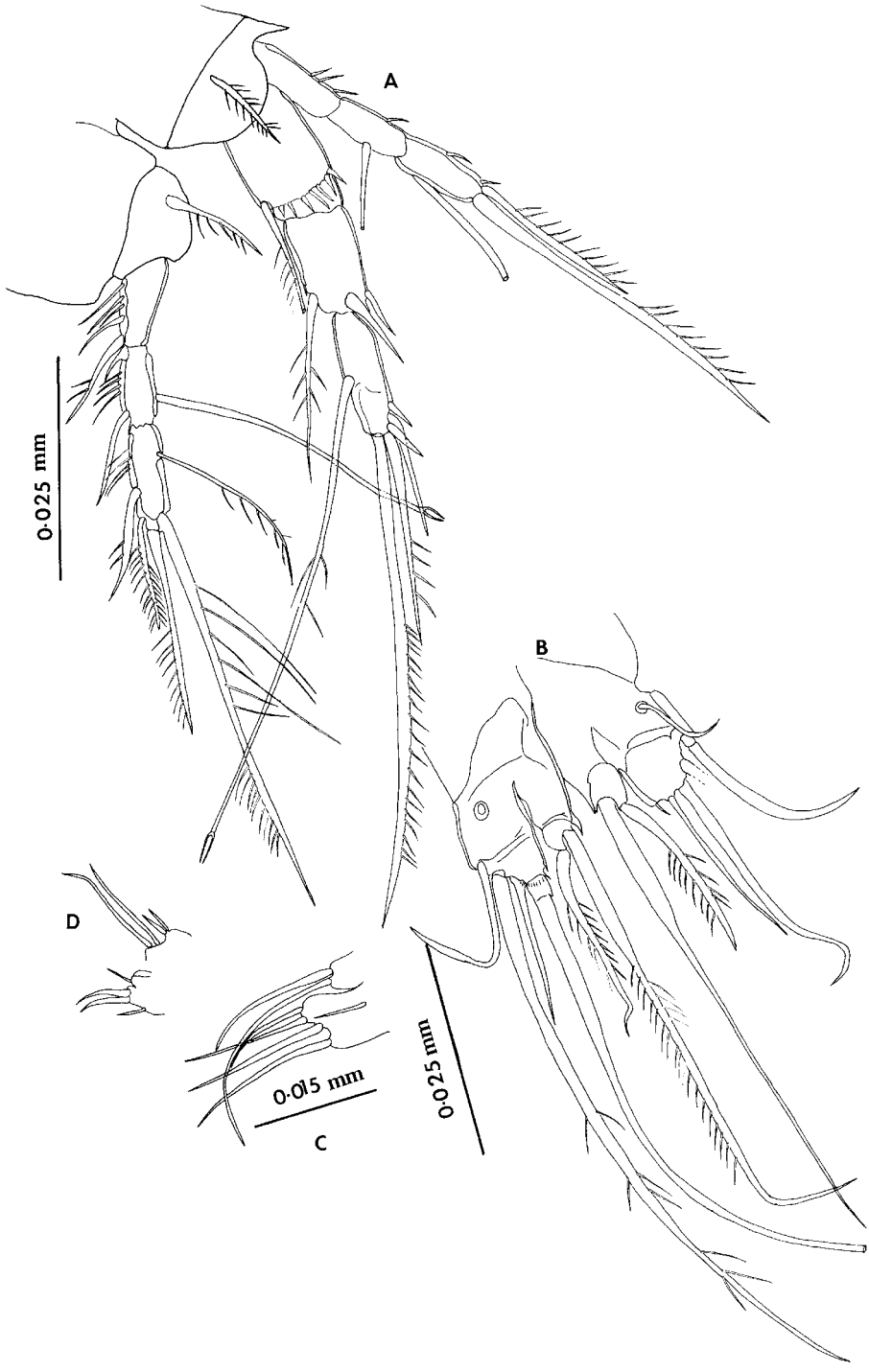

Fig. 8. *Arenosetella bassantae* n. sp. A, ♀ P1; B, ♀ P5; C, ♂ P5; D, ♂ P6.

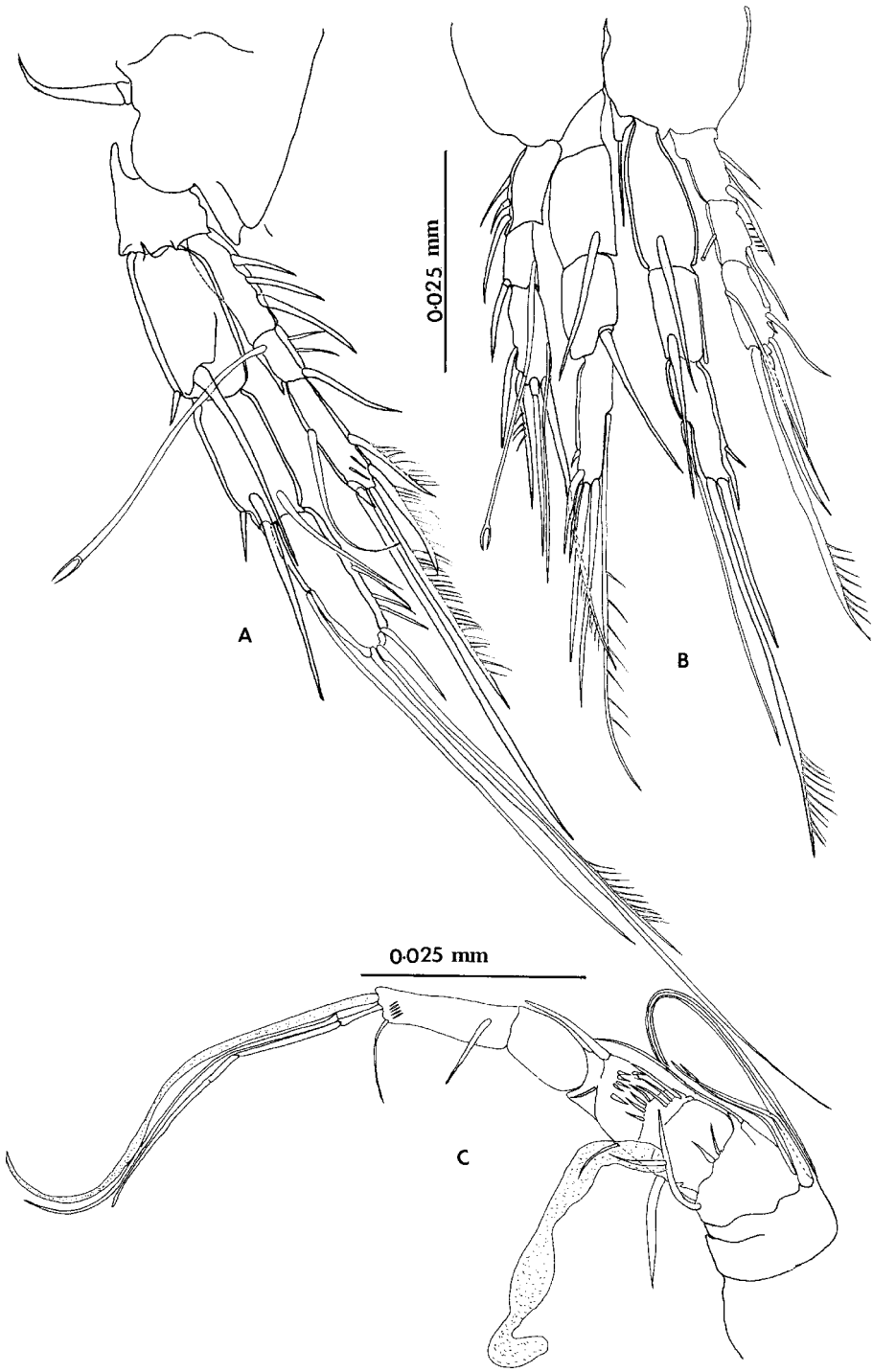

Fig. 9. *Arenosetella bassantae* n. sp. A, ♀ P2; B, ♂ P1; C, ♂ A1 and R.

Fig. 10. *Arenosetella bassantae* n. sp. A, ♀ P3; B, ♀ P4.

P4 (fig. 10B), coxa broad. Basis small with a thick inner setae and a transverse row of spinules on the anterior surface. The setation is similar to that of P1. The middle exopod segment has an inner seta that is bifurcated.

TABLE III

Setation formulae of females' natatory legs of species of *Arenosetella* C. B. Wilson, 1932

Species	P1		P2		P3		P4	
	Exp.	End.	Exp.	End.	Exp.	End.	Exp.	End.
A. bassantae n. sp.	0.1.122	1.2.122	0.1.122	1.2.121	0.1.122	1.2.121	0.1.122	1.2.122
A. tenuissima (Klie, 1929)	0.1.122	1.1.1.20	0.1.122	1.2.120	0.1.122	1.2.120	0.1.222	1.2.120
A. fissilis C. B. Wilson, 1932	0.0.022	1.1.121					4*	4*
A. spinicauda C. B. Wilson, 1932	0.0.1.22	1.1.121					1.1.221	1.1.122
A. germanica s.l. Kunz, 1937	0.1.122	1.1.121	(0)1.1.1221	1.2.121	(0)1.1.122	1.2.121	(0)1.1.(1)222	1.2.121
A. incerta Chappuis, 1954	0.1.122	1.1.120	0.1.122	1.2.120	0.1.122	1.2.120	0.1.222	1.2.120
A. indica Krishnaswamy, 1957	0.0.122	1.1.121	0.0.022	1.2.121			0.0.022	1.2.121
A. madagascariensis Lang, 1965					1.1.122	1.2.221	1.1.122	1.2.221
A. rouchi Lang, 1965	0.1.122	1. 1.120	1.1.122	1.2.120	1.1.122	1.2.120	0?.1?1.222	1.2.120
A. kaiseri Lang, 1965	0.1.222	1.1.121	1.1.122	1.2.121	1.1.122	1.2.121	1.1.222	1.2.121
A. balakrishnani Božić, 1967	0.1.022	1.2.120	0.1.122	1.2.120	0.1.122	1.2.120	1.1.122	1.2.120
*A. limnophila*** Sterba, 1968	0(1).11.122	1(0).10.122	0(1).11.122	1(0).1(0).121	0(1).11.122	1(0).1(0).111	0(1).11.122	1(0).020
A. duriensis Galhano, 1970	0.1.122	1.1.221	1.1.222	1.1.221	1.1.22	1.1.221	1.1.222	1.1.221
A. bidenta Itô, 1972	0.1.122	1.1.121	1.1.122	1.1.121	1.1.122	1.1.121	1.1.222	1.1.121

TABLE III
(Continued)

Species	P1		P2		P3		P4	
	Exp.	End.	Exp.	End.	Exp.	End.	Exp.	End.
A. fimbriaticauda McLachlan & Moore, 1978	0.1.122	1.1.121	1.1.122	1.2.121	1.1.122	1.2.121	1.1.222	1.2.121
A. littoralis Bodin, 1979	0.1.122	1.1.221	0.1.122	1.2.221	1(0).1.122	1.2.221	1.1.1.122	1.2.221
A. germanica galapagoensis Mielke, 1979	0.1.122	1.1.121	1.1.122	1.2.121	1.1.122	1.2.121	0.1.22	1.2.121
A. panamensis Mielke, 1981	0.1.122	1.1.020	0.1.122	1.2.120	0.1.122	1.2.120	0.1.22	1.2.120
A. macronychospina Mielke, 1981	0.1.122	1.1.120	1.1.122	1.2.120	1.1.122	1.2.120	1.1.22	1.2.120
A. germanica germanica Kunz, 1931; according to Mielke, 1981	0.1.122	1.1.121	1.1.122	1.2.121	1.1.122	1.2.121	1.1.222	1.2.121
A. longiseta Kunz, 1983	0.1.122	1.1.020	0.1.122	1.2.120	0.1.122	1.2.120	0.1.222	1.2.120
A. vinadelmarensis Mielke, 1986	0.1.122	1.0.120	0.1.122	1.2.120	0.1.122	1.2.120	0.1.222	1.2.120
A. tricornis Wells & Rao, 1987	0.1.122	1.1.121	1.1.122	1.2.121	1.1.122	1.2.121	1.1.222	1.2.121

* Description of the setation in the original description of *A. fissilis* is incomplete. The number 4 indicates the last segment of the endopod of P4 with 4 setae and spines in all, as revised by Lang (1965).

** Freshwater species.

P5 (fig. 8B), the exopod is one-segmented with three marginal setae and one surface seta. Inner and outer terminal setae are very long, outer seta plumose, others are bare. The exopod is not distinctly separated from the baseoendopod. The outer margin of the baseoendopod has two setae: one long and plumose, the other one bare.

Genital field (fig. 6D), subdivision of the double somite is not clearly visible. Genital pore circular.

Male; based on one adult ♂ 342 μm long, the allotype, measured from the anterior margin of the rostrum to the posterior margin of the caudal rami. Paratype ♂♂ range from 342 μm to 464 μm ($N = 15$; $\bar{x} = 382.4$ μm; $s = 47.58$). Sexual dimorphism in A1, setation of endopods P1, P5, P6, and body somites. The sixth and seventh somites are not fused as in the female.

A1 (fig. 9C), 6-segmented, the 1st to 5th segments are broad and somewhat swollen. The 3rd and 6th segments each bear transverse rows of setules. The 3rd segment bears a robust aesthetasc. The 6th segment is twice as long as wide and carries a thinner aesthetasc terminally. Antennae, mandibles, maxillules, maxillae, maxillipeds, and P2 to P4 similar to those of the female.

P1 (fig. 9B), the surface setae on the middle endopod segment is absent.

P5 (fig. 8C), exopod is one-segmented with three terminal setae and one surface seta. Baseoendopod with two setae, the inner seta is longer than the outer one. All setae are bare and slender.

P6 (fig. 8D), a distinctly asymmetrical structure. Inner side with two thick, short setae, and two smaller setae. Outer side with two long, slender setae and two small setae.

Variability. — Variation of P1 to P4 setation of both female and male was not observed in any of the dissected paratypes. Some variability was found in the size of male specimens. In one dissected paratype male, the caudal rami were ornamented with transverse rows of fine setules.

Etymology. — This species is named for the senior author's daughter, Bassant, whose name is derived from the name of a flower from the valley of the River Nile. Hence, *bassantae* is a noun in the genitive singular.

Remarks. — *Arenosetella bassantae* has similarities with six known (sub)species of the genus out of 23 species described world-wide to date (table III). These six similar (sub)species are: *A. germanica germanica* Kunz, 1937, *A. rouchi* Lang, 1965, *A. madagascariensis* Lang, 1965, *A. bidenta* Itô, 1972, *A. germanica galapagoensis* Mielke, 1979, and *A. panamensis* Mielke, 1981; they are all characterized by having bifid, spiniform processes, i.e., claw-like structures on the dorsal surface of the anal somite (McLachlan & Moore, 1978). *A. bassantae* differs

from the others by the setation of P1 to P4. The closed spiniform structure gives the appearance of four separate spines rather than the claw-like structure described for the other species. The difference in setation of the present species and the structure of the spiniform processes on the anal somite, confirm that *A. bassantae* is a new species and that it is distinct from any of the other species tabulated.

This species was common at three sandy beaches, El Mamoura, Bir Masoud, and El Shatby, studied in Alexandria, Egypt, comprising 19%, 14%, and 8% of the harpacticoid fauna, respectively.

Family CYLINDROPSYLLIDAE Sars, 1903

Genus *Arenopontia* Kunz, 1937

Arenopontia nesaie Cottarelli, 1975 (figs. 11-12)

Arenopontia nesaie Cottarelli, 1975: 65, figs. 1-23.

Material examined. — 130 ♀♀, 122 ♂♂, and 10 copepodites. All material from Bir Masoud, El Mamoura, and El Shatby beaches, where it comprised 68%, 59%, and 46% of the total harpacticoid community, respectively.

Distribution. — Found also in interstitial littoral waters of Sardinia.

Additional description. — Female (fig. 11A), with total lengths ranging from 305 μm to 427 μm. Body elongate, cylindrical, worm-like, typical for the usual shape of the family. Cephalic shield and thoracic somites smooth. Abdominal somites with palisaded hyaline frill. Body length 8 times the greatest width. Rostrum small, subtriangular. Caudal rami (fig. 11C) twice as long as wide, with seven ramal setae. Caudal rami characterized by the presence of processes in the form of triangular tubercles, which are the main characteristic feature of *A. nesaie*.

Setation of P1-P4:

	Exopod			Endopod	
	1	2	3	1	2
P1	1	0	121	11	020
P2	1	1	130	0	110
P3	1	1	030	1	010
P4	1	1	030	1	020

Male (fig. 11B), length ranging from 244 μm to 305 μm. Sexual dimorphism exists in A1, P5, P6, and body segmentation.

Remarks. — Analysis of the present material shows it to be similar to the description of *A. nesaie* Cottarelli, 1975, with which it is identical in the structure of the mandibular palp (fig. 11I), the morphology of the P1 endopod (fig. 11D), the distal ornamentation of the abdominal somites (fig. 11A, B), and in the presence of tubercles on the caudal rami (fig. 11C). The present material also shows some

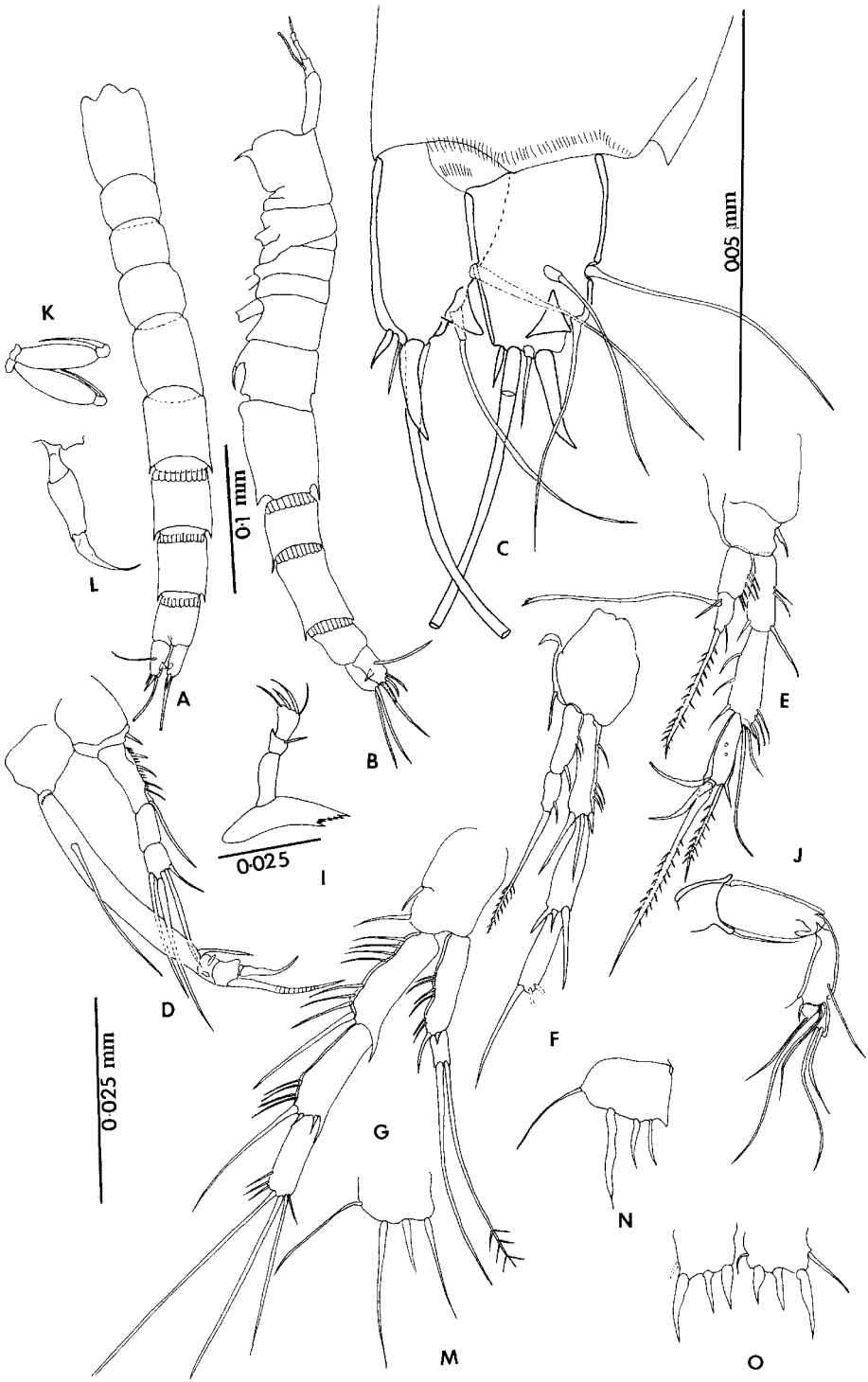

Fig. 11. *Arenopontia nesaie* Cottarelli, 1975. A, ♀ dorsal; B, ♂ lateral; C, ♀ caudal rami; D, ♀ P1; E, ♀ P2; F, ♀ P3; G, ♀ P4; I, ♀ Md; J, ♀ A2; K, ♀ Mxp; L, ♂ Mxp; M, ♀ P5; N-O, ♂ P5.

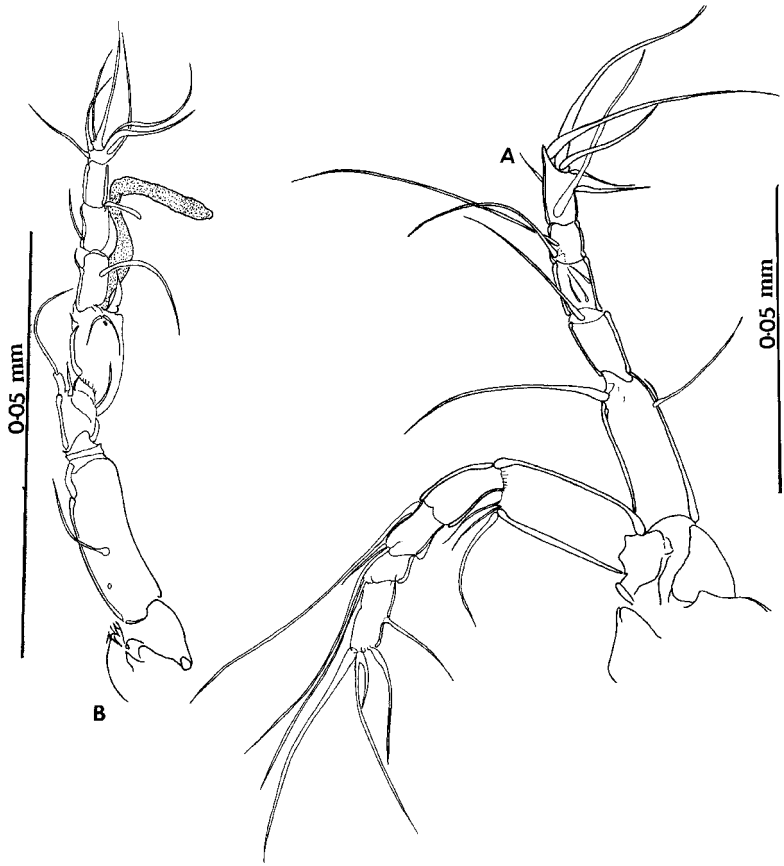

Fig. 12. *Arenopontia nesaie* Cottarelli, 1975. A, ♀ A1 and R; B, ♂ A1.

differences with the original series. The main difference is the number of caudal setae, seven in the present specimens compared to six in the original, published account. The two aesthetascs are difficult to discern on the female antennule (fig. 12A). Only one aesthetasc is clearly visible in male specimens. The original publication (Cottarelli, 1975) did not include a description of the P1 to P4 setation. There are slight variations of the P2 to P4 setation between the present material (fig.11D, E, F, G) and the drawings in Cottarelli's (1975) paper. It is not obvious from the original description if the distal expod segment of P2 has 3 or 4 setae. In the present material, the last expod segment of P2 has 4 setae. Moreover, the proximal segment of the endopods of P3 and P4 definitely has one seta in the present material, while this is not clear in the original description. This variation in setation might be due to missing setae in the original description, or because both setae have very robust setules, which makes it difficult to differentiate. Except for these variations, the four main characteristic features (mandibular palp, P1

endopod, abdominal somites ornamentation, and tubercles of the caudal rami) confirm that the present material is identical to *A. nesaie* as described by Cottarelli (1975).

Family PARAMESOCHRIDAE Lang, 1984

Genus *Kliopsyllus* Kunz, 1962

Kliopsyllus constrictus egyptus n. subsp. (fig. 13)

Material examined. — 100 ♀♀, 80 ♂♂, and 20 copepodites. Holotype: ♀, dissected; 10 ♀♀ paratypes preserved in whole; allotype: ♂, dissected; and 10 ♂♂ paratypes in whole [BM(NH) 2000.47-66].

Type locality. — The holotype was collected at the sandy beach El Shatby at Alexandria, Egypt.

Description. — Female (fig. 13A-D); based on non-ovigerous holotype ♀. Body length of paratypes ranges from 265 μm to 305 μm. Body cylindrical, elongated, distinctly tapering posteriorly, somewhat constricted intersegmentally in the metasome. Rostrum small, triangular. Cephalic shields and body somites smooth. The last two abdominal somites with very fine ornamentation (fig. 13A). Caudal rami slightly more than four times as long as wide and about three times as long as the anal somite, bearing seven caudal setae (fig. 13B).

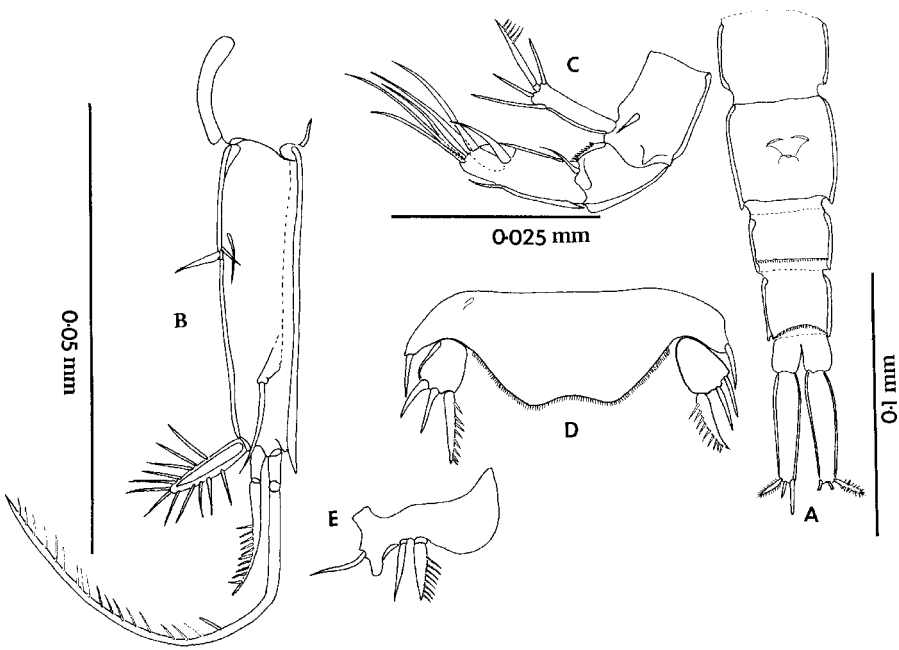

Fig. 13. *Kliopsyllis constrictus egyptus* n. subsp. A, abdominal somites; B, caudal rami; C, A2; D, ♂ P5; E, ♂ P6.

A2 (fig. 13C), basis has one inner, surface seta. The proximal endopod segment has two inner setae. Distal endopod segment with seven setae in total. Exopod one-segmented with four setae. The inner distal seta of the exopod is unique, with a tiny base and inner, plumose spinules.

Male (fig. 13D, E), sexual dimorphism exists in A1, P5, P6 and body segmentation. Body length of paratypes 220 to 275 μm.

P5 (fig. 13D), inner free margin of the baseoendopod set with fine setules. Of the three exopod setae of P5 the two outer ones are bare and the inner one is plumose.

P6 (fig. 13E), two basal setae of about the same size; outer bare, inner plumose.

Remarks. — This species exhibits great morphological similarity with the description of *Kliopsyllus constrictus pacificus* Mielke, 1984 (cf. also Mielke, 1987) and at first was thought to be that subspecies. In particular, the mouthparts, the setation of P1 to P4, and P5 ♀ are identical and are not figured here. In spite of the morphological similarity, there are several differences between the Pacific and Egyptian specimens. The body length of the present material is greater than that of the Pacific specimens. The A2 basis (fig. 13C) has one surface seta, which is not figured in the original description. The A2 proximal endopod segment has two setae compared to only one described by Mielke (1984). The inner distal seta on the exopod of A2 has fine plumose spinules, instead of the stout bifurcate structure described by Mielke (1984). There are fine setules on the last two abdominal somites in the present material. The most obvious differences, however, were found in the male P5 (fig. 13D) and P6 (fig. 13E). The inner free margin of the baseoendopod of P5 is set with fine setules, and is not deepened or V-shaped as described by Mielke (1984). The P5 exopod setae are two bare and one plumose, compared to one bare and two plumose in Mielke's (1984) description. The basal seta of P6 is shorter in the present material than in Mielke's (1984) description.

There is also a great geographical gap, because *Kliopsyllus constrictus pacificus* was found in interstitial water of northern and southern Chile and in the Pacific Ocean off Panama. Except for the disjunct geographical distribution and the above-listed six morphological differences, the present material is identical with *K. constrictus pacificus* (cf. Mielke, 1984, 1987). The similarities between the two forms indicate that *K. constrictus pacificus* could have been transported to Egypt, perhaps by ballast water of ships. The Egyptian material, however, is more likely to be a geographical variant of the nominotypical subspecies, because it is clearly distinguishable morphologically by six traits and is likely allopatric with other subspecies. It is not known whether or not the subspecies could hybridize in narrow contact zones. The morphological differences between *K. constrictus pacificus* Mielke, 1984, and the present material are significant and strong enough

to place the Egyptian material in a new Mediterranean subspecies, *K. constrictus egyptus*.

The present material definitely does not belong to *K. constrictus constrictus* (Nicholls, 1935), because the present material has an 8-segmented A1 compared to the 7-segmented A1 of *K. c. constrictus*. The 1-segmented exopod of A2 has four setae, three bare and one spiny, compared to only one bare seta in Nicholls' (1935) description. The endopod of P1 in the present material is two-segmented, while that of Nicholls' (1935) material is one-segmented. The shape of endopod P2 to P4 of the present material is different from that described by Nicholls (1935). The setae of exopod P5 ♀ are not plumose, and the outer margin of the baseoendopod is without setae in *K. c. constrictus.* The P5 ♀ exopod segment of the present material has three setae, two plumose and one bare. The outer margin of the baseoendopod has two plumose setae and the base is devoid of setae.

Of the total harpacticoid fauna, the new subspecies, *K. constrictus egyptus*, comprised 37%, 13%, and 5%, respectively, at the three beaches El Shatby, Bir Masoud, and El Mamoura in Alexandria.

DISCUSSION

There have been four other taxonomic studies of Harpacticoida along the coast of Egypt. Gurney (1927) studied large aggregations of seaweeds at the Gulf of Suez and the Suez Canal. He found 64 species, of which 21 were described as new. This material included *Nitocra spinipes* Boeck, 1864, which species was also found in the present study of the Mediterranean coast. Gurney (1927) commented that Harpacticoida were much less common than would have been the case under similar conditions on the British coast. Steuer (1943) investigated five different stations near El Shatby in Alexandria (El Anfuci, Western Harbor, Eastern Harbor, Pharos, and Ras El Tin). He studied samples collected from deep subtidal areas and seaweed aggregations. Therefore, it is not surprising that none of the species described by Steuer (1943) were found in the present study of shallow subtidal habitats on beaches. Nicholls (1944) described material from near the city of El Ghardaqa, but did not provide information about the habitats studied. Only two families (Diosaccidae and Tetragonicipitidae) and one genus (*Phyllopodopsyllus*) recorded by Nicholls (1944) were also recorded in the present work, but with different species. Noodt (1964) collected samples from coral reefs and algal communities along the Egyptian Red Sea coast. Only one species, *Amphiascus parvus* G. O. Sars, 1906, out of the 20 recorded by Noodt (1964) was found in the current work on beaches. However, Noodt (1964) was not completely confident about his identification. The current study is complementary to existing studies,

because all sampled different habitats along the Egyptian coast. All studies taken together yield a more complete description of communities of Harpacticoida in Egypt.

The geographical distribution of the Harpacticoida in Alexandria indicates that two species are apparently cosmopolitan: *Amphiascus parvus* G. O. Sars, 1906, and *Nitocra spinipes* Boeck, 1864 (cf. Wells & Rao, 1987). *Arenopontia nesaie* Cottarelli, 1975, appears to be endemic to the Mediterranean Sea, while *Phyllopodopsyllus pauli* Crisafi, 1959, is found in both the Mediterranean and the Black Sea. One species from this study is new to the Mediterranean Sea, *Noodtiella toukae* n. sp. This species is not only new to science and the Mediterranean Sea, but also new as a genus to the Mediterranean Sea. The type locality for the genus *Noodtiella* is the Canary Islands (Noodt, 1958) and the genus also occurs in Portugal (Wells, 1965). This genus might have recently invaded the Mediterranean Sea (specifically, the north coast of Africa) by drifting or shipping. *Arenosetella bassantae* n. sp. is new to science, but the genus is common world-wide, especially in the Mediterranean Sea (table III). This new species could be endemic to Egyptian waters. *Kliopsyllus constrictus egyptus* n. subsp. is new to science, but the species *Kliopsyllus constrictus* s.l. (Nicholls, 1935) is cosmopolitan, recorded from Great Britain (Nicholls, 1935; Moore, 1979; Wells, 1963), Germany (Kunz, 1938; Noodt, 1956, 1957), the Atlantic coast of Europe (Bodin, 1974, 1976), Mediterranean Sea (Kunz, 1974; Noodt, 1955), Bulgaria and the Black Sea (Apostolov, 1969; Marinov, 1971, 1975), and the Atlantic coast of the United States (Coull, 1971). The subspecies *K. constrictus orotavae* (Noodt, 1958) has a wide geographical distribution. It was found on the Canary Islands (Noodt, 1958), the French Mediterranean coast (Chappuis, 1954; Delamare Deboutteville, 1954), the Israeli Mediterranean coast (Masry, 1970), and the Indian coast (Rao & Ganapati, 1969). The subspecies *K. constrictus pacificus* appears to be endemic to the Pacific Ocean. It is common in Panama and Chile (Mielke, 1984, 1987). Among the tropical and subtropical locations, the species exhibits a great deal of intraspecific variation, mainly in the length of the caudal rami. The differences between *K. constrictus pacificus* and the present material are sufficient to establish a separate subspecies endemic to the Mediterranean Sea, *K. constrictus egyptus.*

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