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A NEW RECORD OF *PSAMMOPSYLLUS* NICHOLLS, 1945 (COPEPODA, HARPACTICOIDA, LEPTOPONTIIDAE), WITH A DESCRIPTION OF A NEW SPECIES FROM THE BLACK SEA

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ABSTRACT

Psammopsyllus ertunci n. sp. is described from the north coast of Turkey, representing the first record of the genus *Psammopsyllus* in the Black Sea. The new species is morphologically most similar to *P. stri* Mielke, 1983 and is differentiated from other species of the genus by a combination of the following characters in both sexes: (i) number of setae/spines on P5; (ii) shape of inner spine on P5; (iii) ornamentation of distal margin of anal operculum; and (iv) length/width ratio of P1 enp-1. Some dubious records of *P. operculatus* Nicholls, 1945 are reviewed and its alleged variability reported in the literature, discussed.

INTRODUCTION

Taxonomic studies on copepods in Turkey have usually been concentrated on freshwater species (see Ustağlu, 2004, for complete review), and little is known about the parasitic groups (Karaytuğ et al., 2004; Oktener and Trilles, 2004a,b). On the other hand, almost nothing is known about the marine harpacticoid fauna of Turkey. Noodt (1955) reported 52 species and subspecies from the littoral and subtidal zones in the Marmara Sea, and Gündüz (1989) recorded *Mesochra aestuarii* Gurney, 1921 from Bafra Balıkgölü, a coastal lagoon near the Black Sea. Recently, two new species were described from the Black Sea coast (Karaytuğ and Huys, 2004; Huys et al., 2005). Records from the Mediterranean coast of Turkey are thus far lacking.

The genus *Psammopsyllus* was first created by Nicholls (1945), who allocated it to the Stenocaridae Monard, 1927. Later, Krishnaswamy (1956) established a new genus, *Sewellina*, and placed it together with the closely related *Psammopsyllus* in a new subfamily Psammopsyllinae, within the Cylindropsyllidae. Martínez Arbizu and Moura (1994) upgraded the Leptopontiinae to family status to accommodate the subfamilies Leptopontiinae, Psammopsyllinae, and a new subfamily, Arenopontiinae. Huys et al. (1996) only partly accepted this classification and treated the Arenopontiinae as a distinct family. Bruno et al. (1998) also showed that Arenopontiinae are not closely related to the Leptopontiinae and recognized a relationship between the Psammopsyllinae and Parastenocarididae.

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The genus *Psammopsyllus* is characterized by the loss of the exopod on the first leg. Bodin (1997) listed 15 valid species; however, Cottarelli et al. (1999) pointed out that *P. pasquinii* Cottarelli, 1969 should be transferred to the genus *Ichnusella* Cottarelli, 1971. Despite the fact that species of *Psammopsyllus* have been recorded from all continents (Cottarelli et al., 1984), the many studies carried out along the Bulgarian and Romanian coasts of the Black Sea (e.g., Apostolov and Marinov, 1988) have failed to obtain any *Psammopsyllus* species (Bodin, 1997). *Psammopsyllus ertunci* n. sp. is the first record from the Black Sea and is described in detail below.

MATERIALS AND METHODS

Harpacticoids were collected using the Karaman–Chappuis method (Delamare Deboutteville, 1954). Specimens were dissected in lactic acid and the dissected parts were mounted on slides in lactophenol mounting medium. Supporting broken glass fibers were added to prevent the animal and appendages from being compressed by the coverslip and to facilitate rotation and manipulation, allowing observation from all angles. Preparations were sealed with transparent nail varnish. All drawings were prepared using a camera lucida on an Olympus BX-50 differential interference contrast microscope. Measurements were made with an ocular micrometer. Body lengths were measured from the base of the rostrum to the posterior edge of the caudal rami. Body width is given as the widest part of the cephalothorax. Scale bars in illustrations are in µm.

The descriptive terminology is adopted from Huys et al. (1996). Abbreviations used in the text are: ae, aesthetasc; P1–P6, first to sixth thoracopod; exp (enp)-1(2, 3) to denote the proximal (middle, distal) segment of a ramus.

RESULTS

Family LEPTOPONTIIDAE Lang, 1948

Genus ***Psammopsyllus*** Nicholls, 1945

Psammopsyllus ertunci n. sp.

(Figs. 1–4)

TYPE LOCALITY

Turkey, Kastamonu Province, Çatalzeytin Beach, 41º 58′ 20″ N, 34º 13′ 20′ E.

MATERIAL EXAMINED

Holotype ♀ dissected on 8 slides (deposited in NHM under reg. no. 2005.000), collected from type locality, 08.vii.2001, leg. S. Karaytug and S. Sak. Paratypes, 1 ♂ dissected on 7 slides, 1 ♀ dissected on 3 slides, 3 ♂♂ preserved in alcohol (deposited in NHM under reg. no. 2005.000-000), same data as for holotype. Additional paratypes, 1 ♀ dissected on 1 slide, 1 ♀, 2 ♂♂ preserved in alcohol (deposited in the collection of Balıkesir University Zoology Department), TURKEY, 13.ix.2002, collected from

Sarıkum Beach (Sinop Province), 42º 01′ 08″ N, 34º 54′ 02″ E, leg. S. Karaytug and S. Sak.

Description of female holotype. Body slender and cylindrical (Fig. 1A). Total body length 360 µm. Maximum width 38 µm (mean = 35 µm, n = 4) measured at cephalothorax. Rostrum (Fig. 1B) triangular, defined at base, tapering distally, with two delicate sensillae. Pleural areas of cephalothorax not well developed so that cephalic appendages are clearly visible in lateral aspect. All body somites with dorsal and urosomites with ventral irregularly-shaped plates as figured (Figs. 1A and 2B). Hyaline frills smooth and plain on cephalothorax and body somites. Genital double-somite (Figs. 1A and 2B) slightly longer than wide; with four dorsal, two lateral, and two ventrolateral sensillae. Anal somite with two dorsal sensillae and paired pores (Fig. 3F); anal operculum concave and with a spinular row along the distal margin as figured, two spinous processes located laterally. Caudal rami (Fig. 3A,F) about 2.2 times as long as maximum width (measured in dorsal view), distinctly tapering posteriorly; with three strong spine-like elements located distally; with two spinules near the base of seta VII; with seven setae. Seta I minute and located near the base of seta II; seta II plumose and located midway along the dorsal outer margin; seta III plumose; setae IV–VI bare and located terminally; seta VII plumose and located dorsally.

Antennule (Fig. 3C) slender, 6-segmented; segment 1 surrounded by distinct sclerite around proximal posterior margin (Fig. 1B); segment 6 longest, about 3.7 times as long as maximum width; segment 4 with an aesthetasc fused basally to a seta; segment 6 with 11 setae, two terminal ones fused basally. All setae bare except for one plumose seta on segment 2 and two plumose setae on segment 3. Armature formula: 1-[1], 2-[7 + 1 plumose], 3-[1 + 2 plumose], 4-[1 + (1 + ae)], 5-[1], 6-[9 + (1 + 1)].

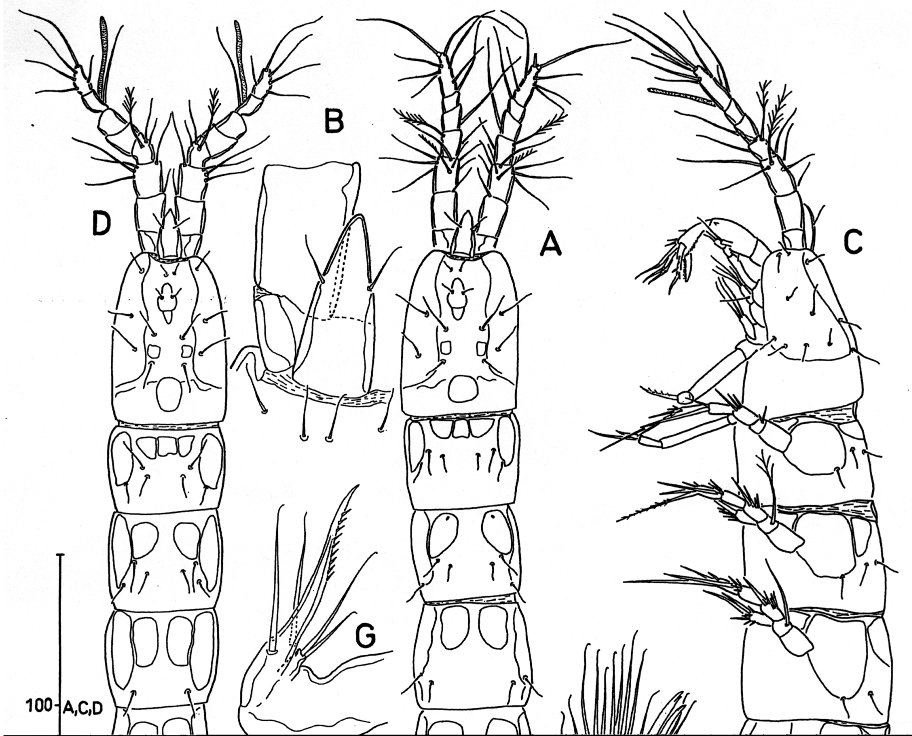
Antenna (Fig. 3B). Allobasis elongate, with two spinular rows located proximally along abexopodal margin. Exopod small with a long naked seta. Endopod 1-segmented with a spinular row and a raised hyaline frill (arrowed in Fig. 3B) along outer margin; lateral armature consisting of 2 spines along outer margin with a few long spinules near their bases; distal 3 geniculate, one small naked spine and one strong unipinnate geniculate spine fused to a vestigial seta.

Mandible (Fig. 1E). Coxa elongate and curved, expanding distally into gnathobase bearing series of small, curved teeth and a naked seta at inner corner. Palp 2-segmented; basis with small seta at inner distal corner and with 3 spinules; endopod with naked seta laterally and 3 naked setae apically.

Maxillule (Fig. 1F). Praecoxa with rectangular, elongate arthrite; arthrite with 2 distally serrate spines and 2 setae around the distal margin. Coxa with small endite bearing 1 long seta. Basis with rami entirely incorporated; palp represented by 9 naked setae.

Maxilla (Fig. 1G). Syncoxa with small endite bearing 2 naked setae. Allobasis with 2 setae, drawn out into claw-like, pinnate endite.

Maxilliped (Fig. 2C). Syncoxa rectangular; unarmed. Basis unarmed, with spinular row on palmar margin. Endopod represented by stout, distally pinnate claw bearing small seta proximally.



[redacted]

Fig. 1. *Psammopsyllus ertunci* n. sp. A—Habitus, dorsal (♀); B—Detail of rostrum, dorsal (♀); C—Habitus, lateral (♀); D—Habitus, dorsal (♂); E—Mandible (♀); F—Maxillule (♀); G—Maxilla (♀).

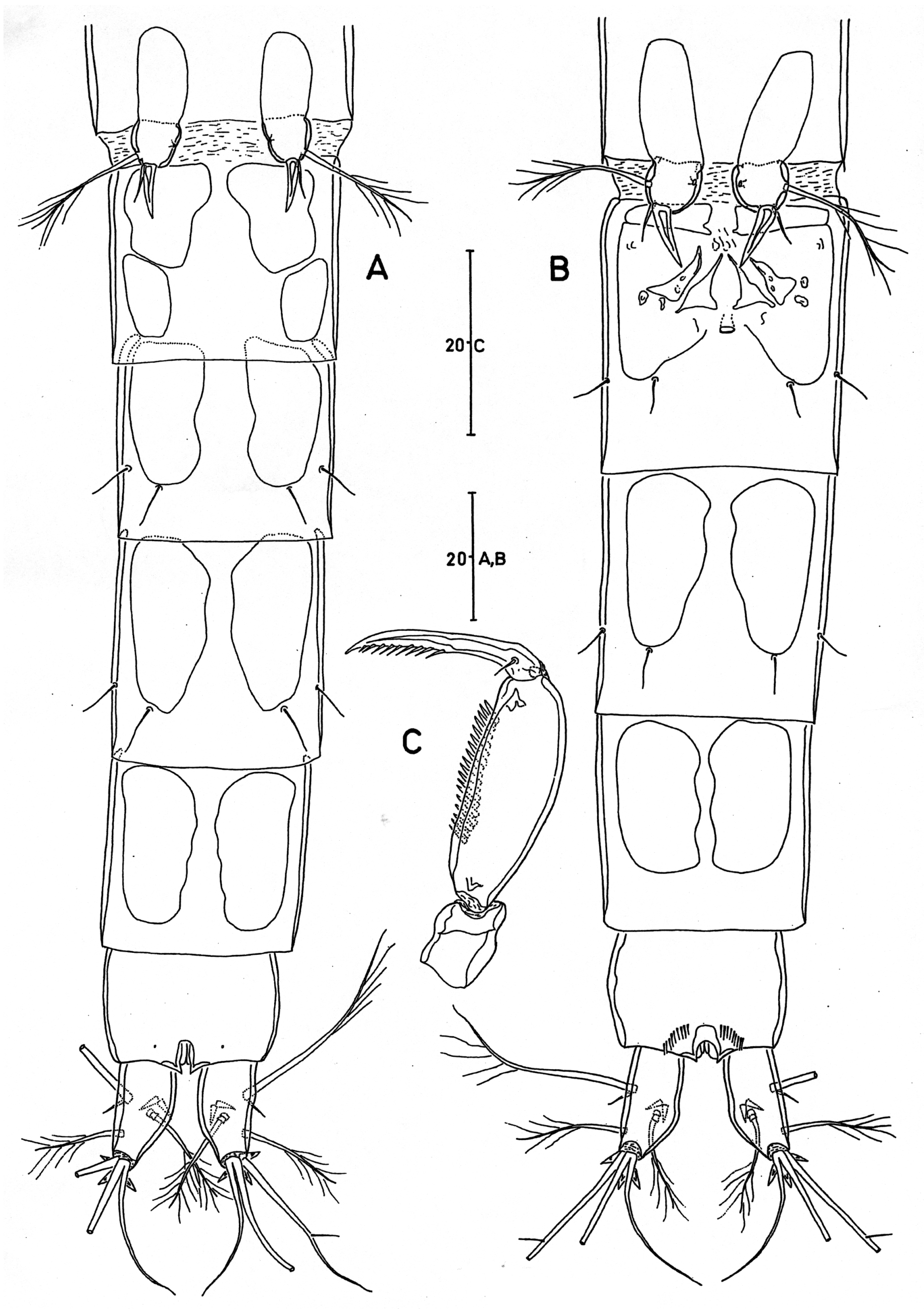


Fig. 2. *Psammopsyllus ertunci* n. sp. A—Urosome, ventral (♂); B—Urosome, ventral (♀); C—Maxilliped (♀).

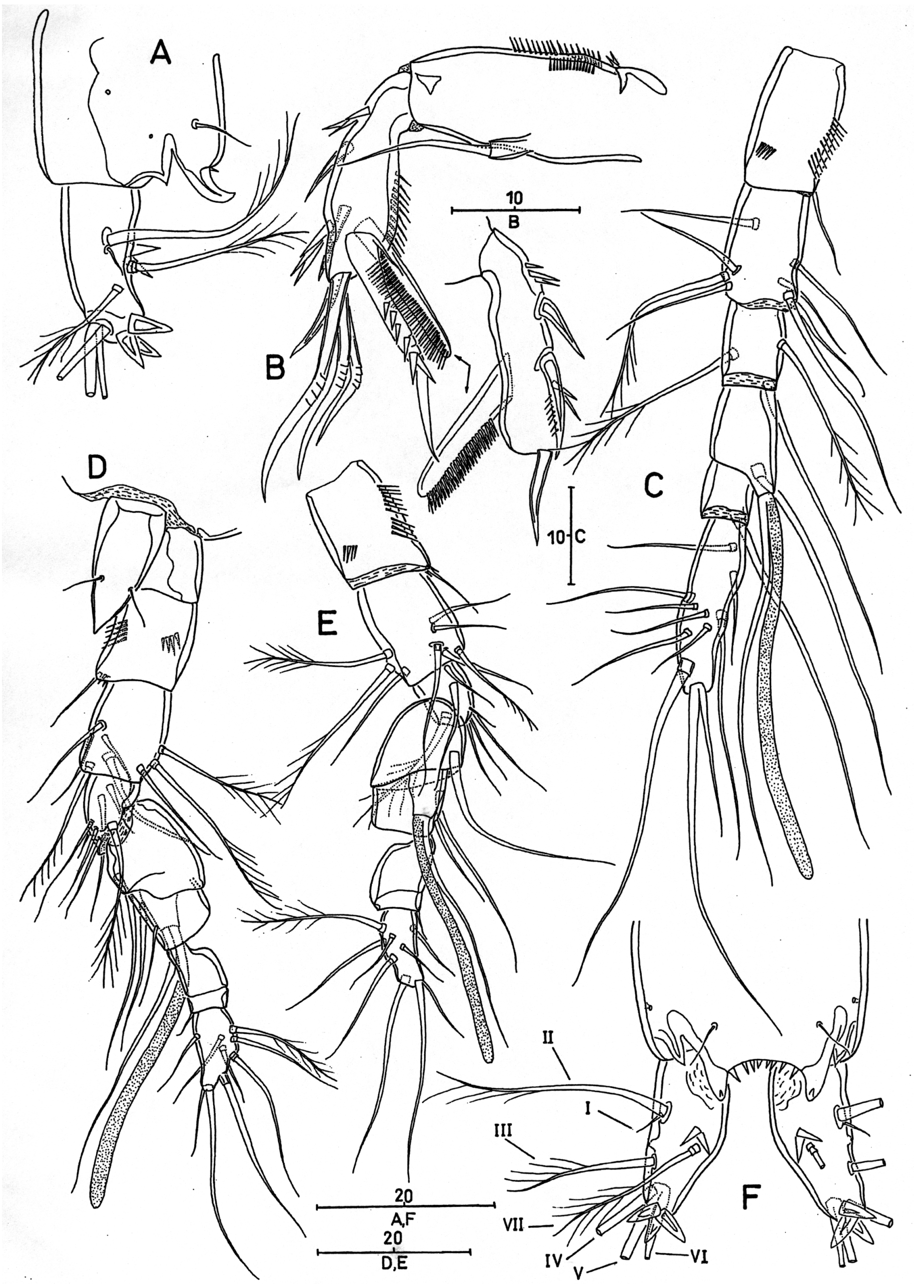


Fig. 3. *Psammopsyllus ertunci* n. sp. A—Anal somite and left caudal ramus, lateral; B—Antenna; C—Antennule (♀); D—Rostrum and antennule, dorsal (♂); E—Antennule, ventral (♂); F—Anal somite and caudal rami (♀), dorsal.

P1 (Fig. 4A). Basis with one naked outer and one bare inner seta. Exopod completely reduced. Endopod 2-segmented; enp-1 long, about 9 times as long as maximum width, and about 3.4 times as long as distal segment; distal segment with a bare hook-like spine and one long geniculate seta distally, and one spinule subdistally.

P2 (Fig. 4B). Coxa naked. Basis with a pore and a spinular row on anterior surface; outer seta bare. Exopod 3-segmented; exp-1 with unipinnate spine and with long spinules along outer and subdistal margins; exp-2 with long unipinnate spine and with spinules along distal margin; exp-3 with 2 spinulose setae and one outer naked spine distally and with spinules near the base of distal setae. Endopod 1-segmented; with transverse spinular row subdistally; with long serrate seta at inner distal corner and two bare setae distally and with spinules near the base of distal setae.

P3–P4 (Fig. 4C, D). Coxae naked. Bases with plumose outer seta; with surface pore anteriorly and with spinular rows distally near the base of endopod and proximal part near the outer edge; exp-1 with few long spinules on middle outer margin and outer distal corner; exp-2 with very long unipinnate outer spine subdistally; exp-3 with one spinulose and one naked spine distally. Endopod 1-segmented; with transverse spinular rows midway along the segment anteriorly and along the distal edge, and with 2 naked spines. Armature formula of swimming legs:

	Exopod	Endopod
P1	———	0.020
P2	0.0.021	111
P3	0.0.020	020
P4	0.0.020	020

Fifth legs (Fig. 2B) represented by single segment (partially fused at base to rounded plate) with completely fused exopod and baseoendopod; with anterior secretory pore near inner margin; with a stout, medially directed spine and minute seta. Outer basal seta long and plumose.

Genital field difficult to observe (Fig. 2B); ornamented with irregularly shaped plates far anteriorly. Median copulatory pore located centrally. Seminal receptacles not confirmed.

Description of male paratype. Total body length 357 µm. Maximum width 38 µm. Ornamentation of body somites generally as in the female (Fig. 1D). Sexual dimorphism in body size, antennule, and in genital segmentation. Antennule (Fig. 3D, E) 8-segmented; haplocer. First segment with one bare seta near distal margin and with two spinular rows ventrally. Second segment with 8 setae, of which 3 are plumose; aesthetasc present on segment 4. Major geniculation between segments 5 and 6. Armature formula: 1-[1], 2-[5 + 3 plumose], 3-[6 + 1 plumose], 4-[1 + (1 + ae)], 5-[2], 6-[0], 7-[1], 8-[6 + 1 plumose + (1 + 1)].

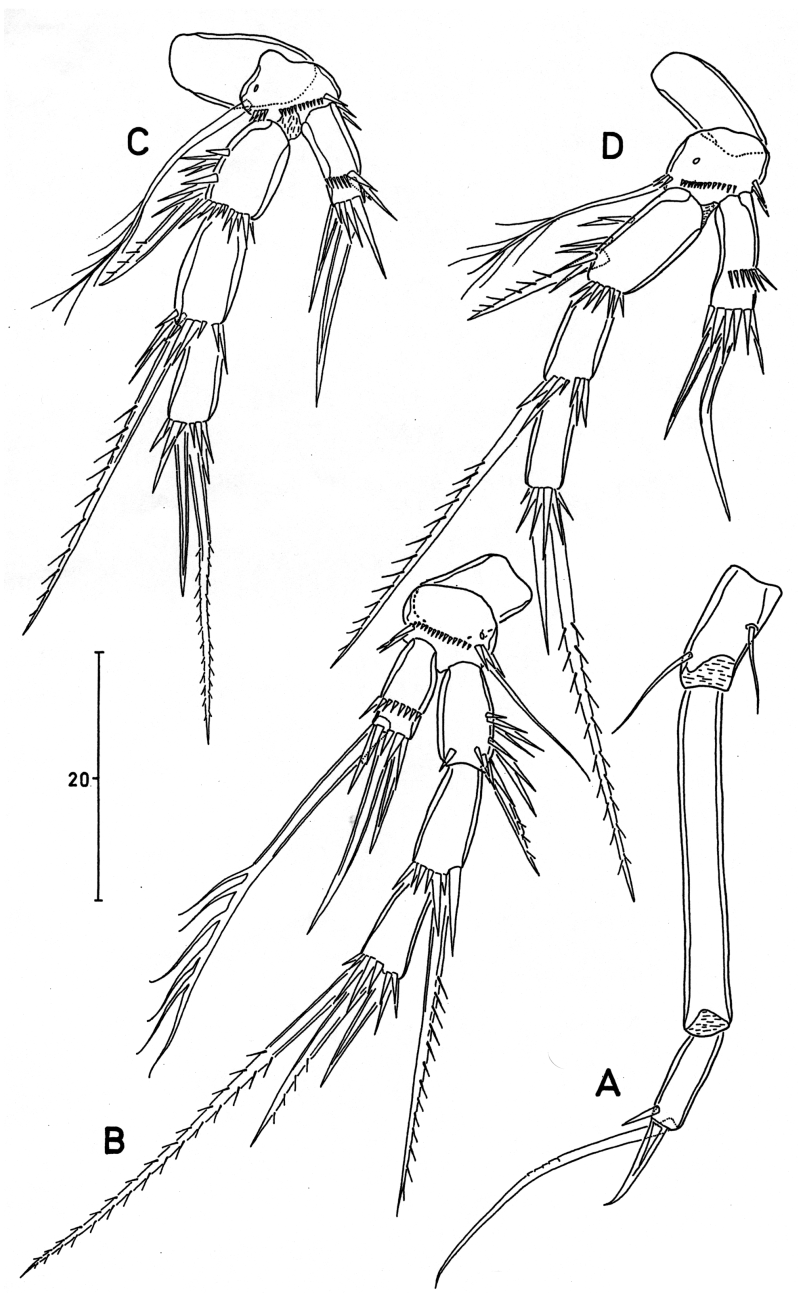


Fig. 4. *Psammopsyllus ertunci* n. sp. (♀) A—P1; B—P2; C—P3; D—P4. All in anterior view.

Etymology. The species is named after Prof. Dr. Ertunç Gündüz (Hacettepe University, Turkey) for his contribution to the taxonomy of Turkish Cladocera and Copepoda.

DISCUSSION

The new species belongs to the *operculatus* group of *Psammopsyllus* species (*P. operculatus*, *P. cornifer* (Chappuis, 1952), *P. delamarei* (Chappuis, 1954), *P. limnicola* Chappuis, 1954, *P. stri* Mielke, 1983, *P. falciseta* Mielke, 1983, *P. argonoi* Cottarelli et al., 1984, *P. longipes* Cottarelli et al., 1984, *P. brevipes* Cottarelli et al., 1984, and *P. pori* Kunz, 1993), which is diagnosed by the loss of the inner seta on the proximal endopod segment of P1 (Cottarelli et al., 1984). It differs from them (except *P. operculatus* and *P. stri*, which are discussed below) by the combination of the following characters in the female: (i) number of setae/spines on P5, (ii) shape of inner spine on P5, (iii) ornamentation of distal margin of anal operculum, and (iv) length/width ratio of P1 enp-1 (see Table 1).

Are these the same?

On the basis of available descriptions in the literature, *P. ertunci* is morphologically most similar to *P. stri* Mielke, 1983 since it shares the same setation pattern on the swimming legs, the presence and shape of the raised hyaline frill on the antennary endopod, the structure of P5, the structure of the anal operculum, the shape of the caudal rami, the shape of the integumental plates on the ventral surface of the urosome, and the spinular ornamentation on the appendages in the female. However, the new species differs from *P. stri sensu* Mielke (1983) by the proportional lengths of the genital double-somite and second abdominal somite, the presence of a ventral spinular row on the anal somite in the female, the length/width ratio of P1 enp-1, the relative length of the outer spine on exp-2 to the middle seta of exp-3 of P2, the ornamentation of the anal operculum, and the presence of seta I on caudal rami (the latter character requires confirmation in *P. stri*). Kunz (1993) extended the distribution of *P. stri* by recording it

Table 1
Salient features differentiating species of the *operculatus* group (*P. operculatus* and *P. stri* are omitted and compared with *P. ertunci* in detail in the text)

	Number of setae/spines on P5	Shape of inner spine on P5	Distal margin of anal operculum	Length/width ratio of P1 enp-1
P. cornifer	2	Strong and slightly curved	Smooth	5
P. delamarei	2	Strong and slightly curved	Smooth	5
P. limnicola	3	Elongated and slender	Serrate	?
P. falciseta	3	Seta-like and long	Smooth	7
P. argoni	4	Strong and slightly curved	Smooth	7
P. longipes	2	Very reduced	Smooth	9
P. brevipes	3	Elongated and slender	Serrate	4
P. pori	3	Seta-like and long	Smooth	6
P. ertunci	3	Strong and slightly curved	Serrate	9

spelled "argonoi" in text

from Hawaii. Despite the fact that Kunz's (1993) description is inadequate in some respects, it is obvious that his material differs fundamentally from both Mielke's (1983) typical *P. stri* and *P. ertunci* in the shape of the anal operculum and the structure of P5 in both sexes. *P. stri sensu* Kunz (1993) should be redescribed before its true identity can be ascertained.

The new species differs from *P. operculatus* sensu Nicholls (1945) by the presence of a small middle seta on the P5, the inner spine of P5 being stouter, and the shape of the anal operculum. *P. operculatus* was originally described from Australia (Nicholls, 1945), but has been recorded from various localities since (Noodt, 1955; Chappuis and Rouch, 1961; Rao and Ganapati, 1969; Cottarelli et al., 1984).

Noodt (1955) stated that his *P. operculatus* collected from the Marmara Sea (from a beach close to the Black Sea) resembled the Australian type material in most aspects, except for the relative length of the caudal rami and some fine details on the swimming legs. It must be noted that the inner seta on the P5 of Noodt's (1955) specimen is longer, possibly suggesting that his material may well be a different species. Examination of many samples from the Anatolian coasts of the Marmara Sea collected by the authors did not reveal any specimens of *Psammopsyllus*.

Cottarelli et al. (1984) redescribed *P. operculatus* from the Volturno River (Italy) and stated that the characters of the specimens agreed sufficiently with the description provided by Nicholls (1945). On the other hand, the following differences observed in the Volturno material were also discussed by Cottarelli et al. (1984): (i) fourth and fifth segments are separated in the male antennule, (ii) fifth segment is followed by 2 segments in the male antennule, (iii) mandibular palp is 3-segmented (this is extremely unlikely) and more setose, (iv) P5 with three elements, and (v) caudal rami with six setae. Cottarelli et al. (1984) also compared specimens identified as *P. operculatus* from other localities (e.g., Cuba, Mexico, Somalia, Indonesia, The Philippines, Sierra Leone) and noted some significant variability in P5, anal somite, and caudal rami.

The description given by Chappuis and Rouch (1961) is almost certainly not based on *P. operculatus*. The structures of the anal operculum, caudal rami, and P5 are significantly different from those of *P. operculatus sensu* Nicholls (1945).

The wide distribution and considerable variability in populations of *P. operculatus* (Noodt, 1955; Chappuis and Rouch, 1961; Rao and Ganapati, 1969; Cottarelli et al., 1984) make one suspect that more than one species is involved. *P. operculatus* needs urgent redescription on the basis of the type material if possible or on the basis of topotypical material since the variability observed between and within the populations mentioned in the literature indicates that the records of *P. operculatus* from other localities may well represent different taxa. It has been shown in various studies that many harpacticoid species previously reported as cosmopolitan in marine interstitial habitats have a restricted geographical distribution (Huys, 1992). Moreover, morphologically close congeners can occur sympatrically in marine interstitial habitats, as demonstrated, e.g., for *Arenopontia* Kunz (Sak, 2004), *Leptopontia* T. Scott (Huys and Conroy-Dalton, 1996), and *Karllangia* Noodt, 1964 (Mielke, 1994). Similar results were observed in freshwater habitats (Karaytug and Boxshall, 1998).

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