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TWO NEW COPEPODS OF THE GENUS *ACARTIA* (COPEPODA, CALANOIDA, ACARTIIDAE) FROM THE COASTAL SEA OF THE SOUTH-WESTERN CRIMEA (BLACK SEA)

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Two New Copepods of the Genus *Acartia* (Copepoda, Calanoida, Acartiidae) from the Coastal Sea of the South-Western Crimea (Black Sea). Pavlova E. V., Shmeleva A. A. — *Acartia mollicula* Pavlova et Shmeleva, sp. n. and *A. eremeevi* Pavlova et Shmeleva, sp. n. are described and figured. The copepods were found in zooplankton samples collected by the Juday net from 0–10 m depth in the coastal sea water of Martyn Bay, Sevastopol. Though the new species, *A. mollicula* and *A. eremeevi*, are similar to *A. clausi* ("small" form), *A. margalefi* Alcaraz and another *Acartia* from Black Sea they have smaller body size, different structure and armature of the fifth legs, and correlation between length/width of prosome and urosome,; besides, *A. mollicula* have the rostrum.

Key words: Copepoda, Calanoida, *Acartia,* Black Sea.

Два новых вида рода *Acartia* (Copepoda, Calanoida, Acartiidae) из прибрежных вод юго-западной части Крыма (Черное море). Павлова Е. В., Шмелева А. А. — Приведено иллюстрированное описание двух новых видов рода *Acartia*: *Acartia mollicula* Pavlova et Shmeleva, sp. n. и *Acartia eremeevi* Pavlova et Shmeleva, sp. n., обнаруженных в зоопланктонных пробах, собранных сетью Джеди из слоя 0–10 м в прибрежных водах около г. Севастополя (Мартынова бухта). Оба новых вида, *A. mollicula* и *A. eremeevi*, близки к *A. clausi* («малая» форма), *A. margalefi* Alcaraz и другим черноморским *Acartia*, но отличаются от них меньшими размерами, различным соотношением длины просомы и уросомы к их ширине, структурой и вооружением пятых ног; у *A. mollicula* имеется рострум.

Ключевые слова: Copepoda, Calanoida, *Acartia,* Черное море.

Introduction

After original description of Acartia (Dana, 1846), Steuer (1923) included 32 species into his monograph of this genus. Of them only 11 species were known from the Mediterranean and the Black Seas (Rose, 1933). Later, six species from the Atlantic Ocean were added to the list (Bradford, 1976) and generus Acartia was revised (Bradford-Grieve, 1999). F. Vives and A. A. Shmeleva (2007) reported about 17 species of Acartia from the Mediterranean Sea. A number of recent publications mentioned copepods formerly unknown in the Black Sea (Unal et al., 2002; Shmeleva, Selifonova, 2005; Selifonova, Shmeleva, 2007; Shmeleva et al., 2008; Shmeleva et al., 2009). Our paper focuses on a detailed description of two new copepods of the genus Acartia found in the plankton samples regularly collected during 2008 in Martyn Bay of Sevastopol (Black Sea). Acartia are small copepods with the oval or elongated body 0.5 to 1.70 mm long. Though small in size, copepods of this genus are an important food item for plankton-eating fishes. Acartia are common in coastal sea water of the tropical Indian and Atlantic Oceans and in the Black Sea.

Material and methods

Samples of plankton were collected in Martyn Bay of Sevastopol from a specialized inshore motor-boat at stations located about 100 m off the shore ($\varphi = 44°37'06''$, $\lambda = 33°30'50''$). The Small Martyn Bay is in close vicinity to the entrance to Sevastopol Bay separated from the open sea by a pier. Samples were taken monthly year round beginning from January 2008, from the depth 10 m and up to the surface, with a plankton net (36 cm

in diameter, 156 μm mesh size). The plankton samples were preserved with borax buffered formaldehyde, final concentration of 4%, for further examination at the laboratory of the Institute of Biology of the Southern Seas, Sevastopol (IBSS). Total length of specimens was measured from the frontal edge of head to the end of caudal rami. Prosome of female copepods was measured from the anterior edge of head to the base of genital somite.

Abbreviations of morphological structures follow that in Vyshkvartzeva (2000; 2005). All the measurements are given in millimeters.

Acartia mollicula Pavlova et Shmeleva, **sp. n.** (fig. 1–3)

Material examined. Holotype ♀: Black Sea, Martyn Bay (Pavlova, IBSS, No 262). Paratypes: 20 ♀ + V copepodite ♂ (IBSS, No 263).

Female (fig. 1, *1–8*). Total length 0.575–0.70 (holotype 0.63). Body elongate, dark, with nauplius eye. Prosome widest in middle somite, with head and 4 thoracic somites (fig. 1, *1*). Rostrum small, without rostral filaments (fig. 1, *5*). Posterolateral corners of somite pointed and symmetrical. Prosome and pedigerous somites unequal. Prosome to urosome ratio 76.0 : 24.0; urosome 3-segmented, symmetrical, without any tooth and spines on the distal margin (fig. 1, *2*). Genital somite nearly as long as wide, symmetrical in dorsal view and ventral surface, without processes, with lateral swellings at both sides, symmetrical and equal caudal rami 2.5 times as long as wide (fig. 1, *2, 4*).

Antennula 19-segmented, almost reaching posterior margin of genital somite when pressed against the body. Segment with one spine (fig. 1, *6*).

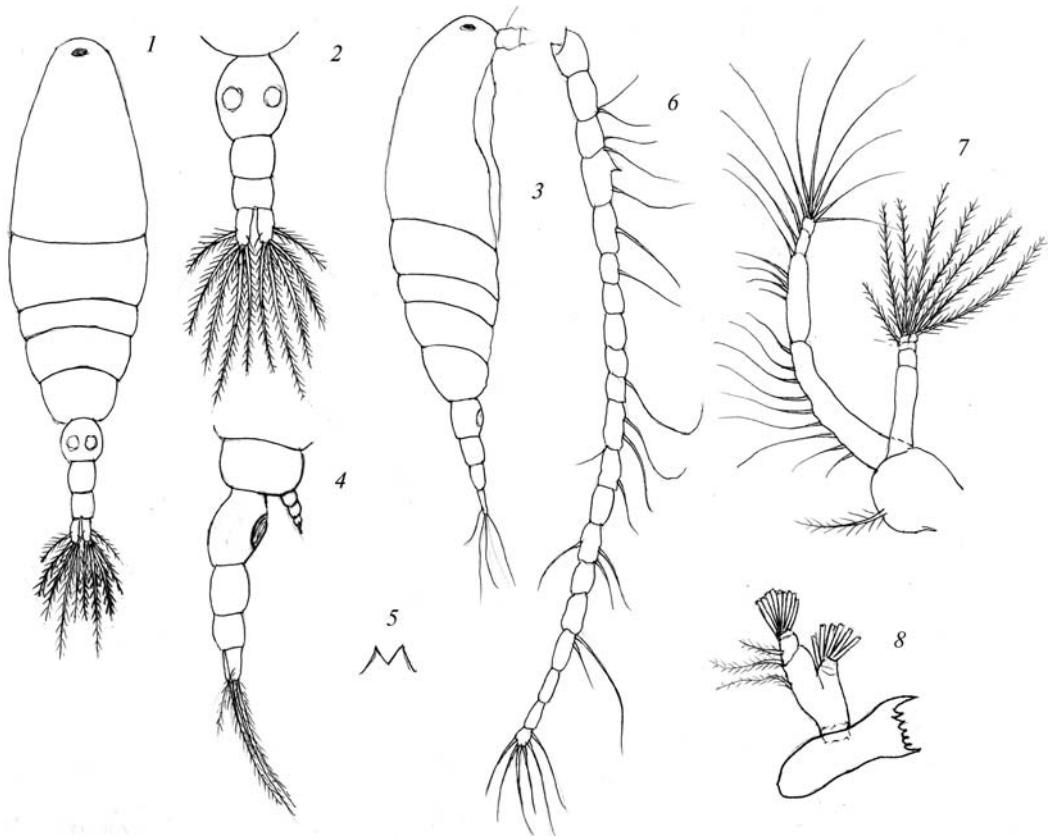

Fig. 1. *Acartia mollicula*, ♀: *1* — dorsal view of whole specimen; 2 — urosome in dorsal view; 3 — lateral view of whole specimen; *4* — urosome, lateral view; *5* — rostrum, dorsal view; 6 — antennula; *7* — antenna; *8* — mandible.

Рис. 1. *Acartia mollicula*, ♀: *1* — общий вид, дорсально; *2* — уросома, дорсально; *3* — общий вид, латерально; *4* — уросома, латерально; *5* — рострум дорсально; *6* — антеннула; *7* — антенна; *8* — мандибула.

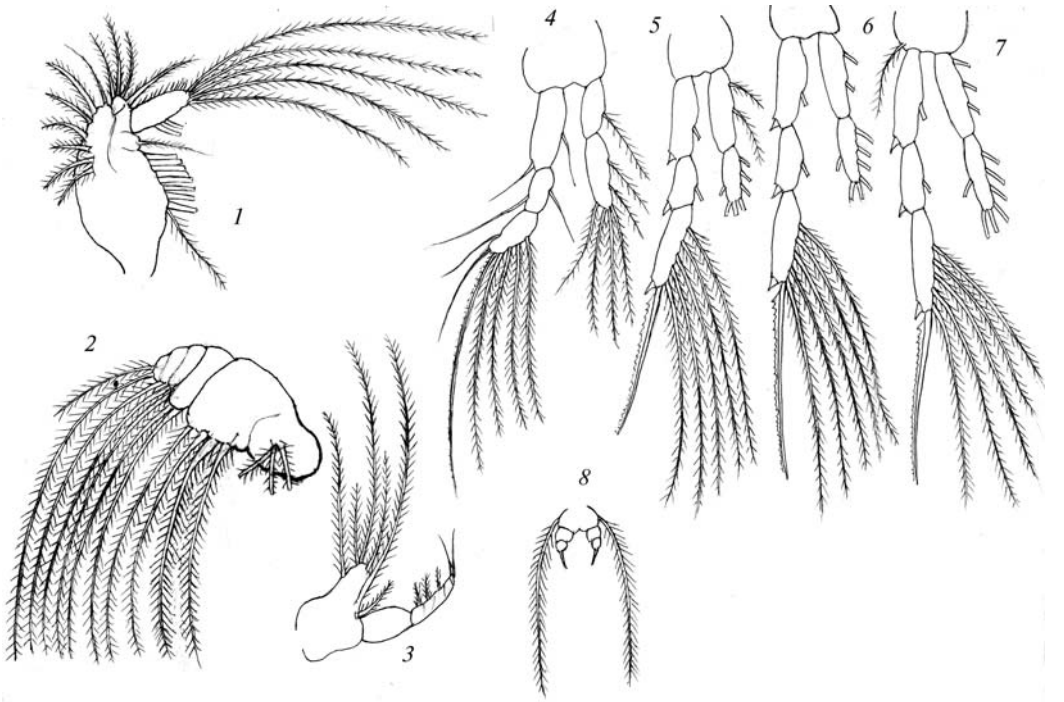

Fig. 2. *Acartia mollicula* sp. n., ♀: *1* — maxillulla; *2* — maxilla; *3* — maxilliped; 4 — first swimming leg; *5* — second swimming leg; *6* — third swimming leg; *7* — fourth swimming leg; *8* — fifth leg.

Рис. 2. *Acartia mollicula* sp. n., ♀: *1* — максиллула; *2* — максилла; 3 — максиллипеда; *4* — первая плавательная нога; *5* — вторая плавательная нога; *6* — третья плавательная нога; *7* — четвертая плавательная нога; *8* — пятая плавательная нога.

Antenna and mouthparts like in other *Acartia* (cf. *A. clausi*: Gisbrecht, 1892). Antenna (fig. 1, *7*) with distinctly separated coxa and basis bearing one seta; basis and first endopodal segment fused, forming elongated allobasis bearing six proximal setae and one distal seta along inner margin. Second endopodal segment elongated, with seven setae; third endopodal segment short, with seven setae. Exopod short, 4-segmented; setation formula of 1, 2, 2, 3. Labrum large, endopodite absent.

Mandible: coxa with well developed gnathobase; basis bearing one seta covered with spinules; endopod 2-segmented, with two and nine setae on the first and the second segments, respectively; exopod 5-segmented, with setation formula of 1, 1, 1, 1, 2 (fig. 1, *8*).

Maxillula: praecoxa and coxa incompletely fused; precoxal segment with nine elements; coxa with endite bearing three setae and with nine setae on the epipodite; basis with one inner seta and one outer seta; endopod absent; exopod bearing seven setae furnished with hairs along inner margin (fig. *2, 1*).

Maxilla. Praecoxa and coxa with 2 endites and 14 setae, with formula: 5, 2, 3, 2, 2 (fig. 2*, 2*).

Maxilliped comprising robust syncoxa and basis of 2-segments endopod; syncoxa with setation formula of 0, 2, 2, 1; basis bearing one short seta; the first and second endopodale segments having three and two short setae (fig. 2, *3)*.

Swimming legs of the first to fourth pairs (fig. 2, *4*–*7*) biramous, with 3-segmented exopod and 2-segmented endopod. First leg without basal inner seta; second and third exopodal segment covered with setae on anterior distal area (tabl. 1). Fifth legs 3-segmented (including one distal segment of basipod) and symmetrical, without large spine. Proximal and distal segments without setae on posterior surface. Distal segment slightly longer than antecedent. Single lateral seta very long, 10 times longer than spine (fig. 2, *8*).

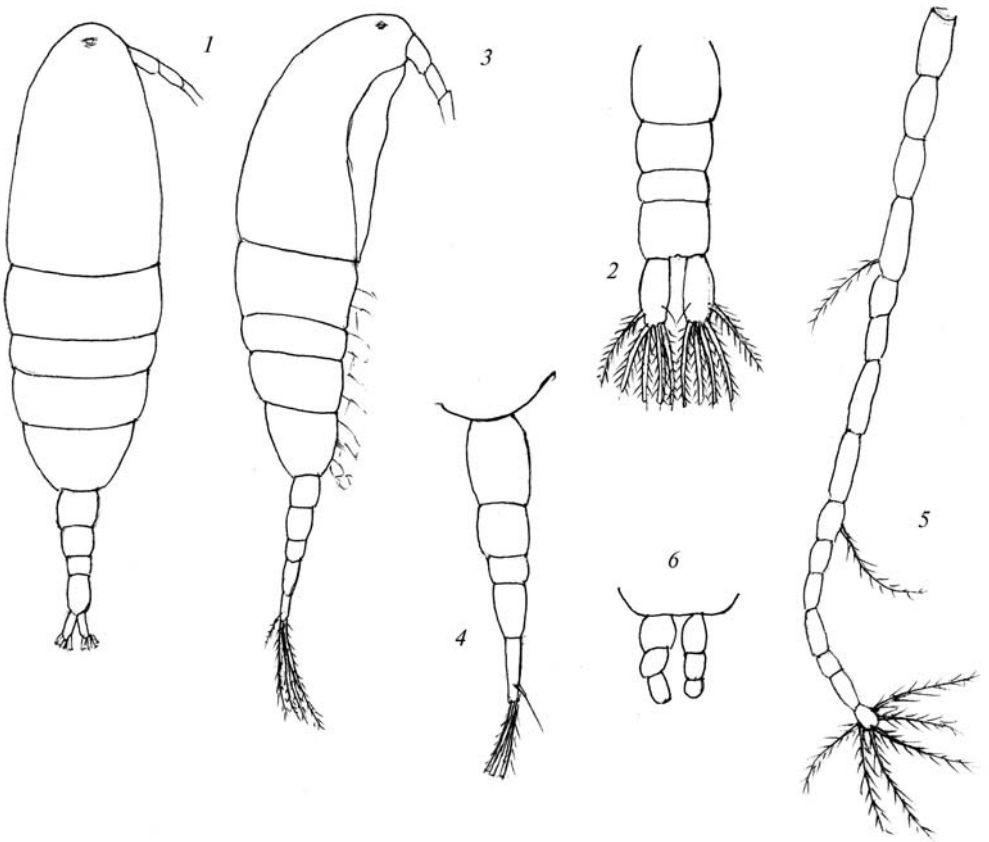

Fig. 3. *Acartia mollicula* sp. n., ♂: *1* — dorsal view of whole specimen; *2* — lateral view of whole specimen; *3* — urosome, dorsal view; *4* — urosome, lateral view; *5* — right antennula; *6* — fifth leg.

Рис. 3. *Acartia mollicula* sp. n., ♂: *1* — общий вид, дорсально; *2* — общий вид, латерально; *3* — уросома, дорсально; *4* — уросома, латерально; *5* — антеннула правая; *6* — пятая нога.

Male. Copepodite stage V (fig. 3, *1–6*). Total length is 0.6 mm. Cephalosome very similar to that of females (fig. 3, *1, 2*). Rostrum very small. Urosome symmetrical, without processes. Second and third urosomal somites equally long. Fourth urosomal somite longer than third. Caudal rami symmetrical, about three times as long as wide, with straight inner margins (fig. 3*, 3*). Caudal setae as in females. Right antennula not geniculate (fig. 3*, 5*). Urosome, view dorsal and lateral, as on fig. 3, *3, 4*). Except for fifth legs other appendages as in females. Fifth legs are 3-segmented, left leg shorter. Distal segment of fifth leg with single small spine (fig. 3*, 6*).

Etymology. *A. mollicula* sp. n. is the smallest member of the genus *Acartia*.

Table 1. Formulas of the armature of swimming legs in *Acartia mollicula* females
Таблица 1. Формулы вооружения плавательных ног самок *Acartia mollicula*

	Coxa	Basis	Exopodal segments	Endopodal segments
P_1	0–0	0–0	1–0; 1–1; 1, 1; 1, 4	0–1; 1, 2, 3
P_2	0–0	0–0	0–1; 0–1; 1, 0, 1, 5	0–2; 1, 2, 4
P_3	0–0	0–0	0–1; 0–1; 0, 1, 5	0–2; 1, 2, 4
P_4	0–0	1–0	0–1; 0–1, 0, 1, 5	0–3; 1, 2, 3

* This formula is also valid for *A. eremeevi.*

Notes. Female *A. mollicula* sp. n. somewhat resembles *A. clausi* (the "small" form, by D. A. Potemkina, 1940) and *A. morgalefi* Alcaraz 1976 (Alcaraz, 1976) in the appearance and dark color, differing by the presence of posterodorsal spines on the second urosomal segment. Their size and leg structure are also different (tabl. 2).

Acartia eremeevi Pavlova et Shmeleva, **sp. n.** (fig. 4–6)

Material examined. Holotype ♀: Black Sea, Martyn Bay, (Shmeleva, IBSS, No 264). Paratypes: in the same place as the holotype, ♂ (No 265); 22 ♀, 1 ♂ (Shmeleva, No 266, IBSS).

Female (fig. 4, *1–10*). Total length 0.73–0.76 mm. Body elongated, slightly coloured, with nauplius eye. Head rounded, rostrum small, without rostral filaments. Urosome about 4 times as long as prosome; posterior end rounded and symmetrical, without any spines. Dorsolateral side of fifth pedigerous segment without row of spicules (fig. 4, *1, 2*). Urosome 3-segmented, symmetrical, without spines and setae on distal end. Ratio of urosome segments and caudal rami 45.5 : 21.8 : 18.2 : 14.5 : 100 (fig. 4, *3*). Genital somite laterally inflated (fig. 4, *4*). Caudal rami symmetrical, 1.4 times as long as wide, lateral end without hair.

Antennula (fig. 4, *5*) 19-segmented, extended posteriorly to genital segment.

Antenna (fig. 4, *6*): coxa with single seta, basis fused with endopod segment bearing 8 setae along inner mid-margin, one terminal seta; second and third segments incompletely fused, with 7 setae each; exopod 4-segmented, with setae formula 1, 1, 3, 3. Antenna and all mouthparts usual for genus (Giesbrecht, 1892).

Gnatal lobe of mandible (fig. 4, *7*) with 6 primary and 2 accessory teeth. Basis with 1 medial seta, endopod with two incompletely fused segments, first segment with 2 and second with 9 setae; partly fused 3-segmented exopod with basis, setae formula 1, 1, 4.

Praecoxal segment of maxillula (fig. 4, *8*) bearing 8 spine-like setae and 1 weak seta, coxal endite with 3 setae, coxal epipodite with 9 distinct setae. Endopod and exopod incompletely fused, with 5 and 2 setae each.

Maxilla (fig. 4, *9*). Praecoxa and coxa with 2 endites and 14 setae, with formula: 5, 2, 3, 2, 2.

Maxilliped (fig. 4, *10*). Praecoxa and coxa fused, with 5 setae; basis bearing spine-like seta; endopod 4-segmented, first 3 segments incompletely fused, with 1 seta on each, terminal segment with 2 setae.

Table 2. The dimensions and morphological variations of female *Acartia mollicula* sp. n., *A. eremeevi* sp. n., *A. margalefi* and *A. clausi*
Таблица 2. Размеры и морфологические различия самок *Acartia mollicula* sp. n., *A. eremeevi* sp. n., *A. margalefi* and *A. clausi*

Characteristics	*A. mollicula* n = 20	*A. eremeevi* n = 22	*A. clausi* ** n = 26	*A. margalefi* ** n = 26
Body length, average size, mm	0.63	0.74	0.9	
Body length, extreme size	0.575–0.70	0.67–1.0	0.8–1.5	0.764–0.850
Prosome/urosome	3.16	4.0	2.9	2.6–3.1
Prosome: length/width ratio	2.7	2.8–3.0	3.1	2.7–2.9
Gn. segm. length/width ratio	1.24	1.0	1.3–1.4	1.1–1.3
Furcal rami: length/width ratio	2.5	1.3	1.5–2.0	2.0–2.3
Spines on the metasome posterolateral edges	absent	absent	present	present
P^5 lateral setae cf. term. spine.	10 times longer l	3 times longer	2 times longer	
Rostrum	small	absent	absent	absent

* Cites from Table 1 the dimensions for *Acartia margalefi* (Sevastopol) adopted from Belmount, Mazzocchi, 1997.

** From the figes A. Steuer (1923).

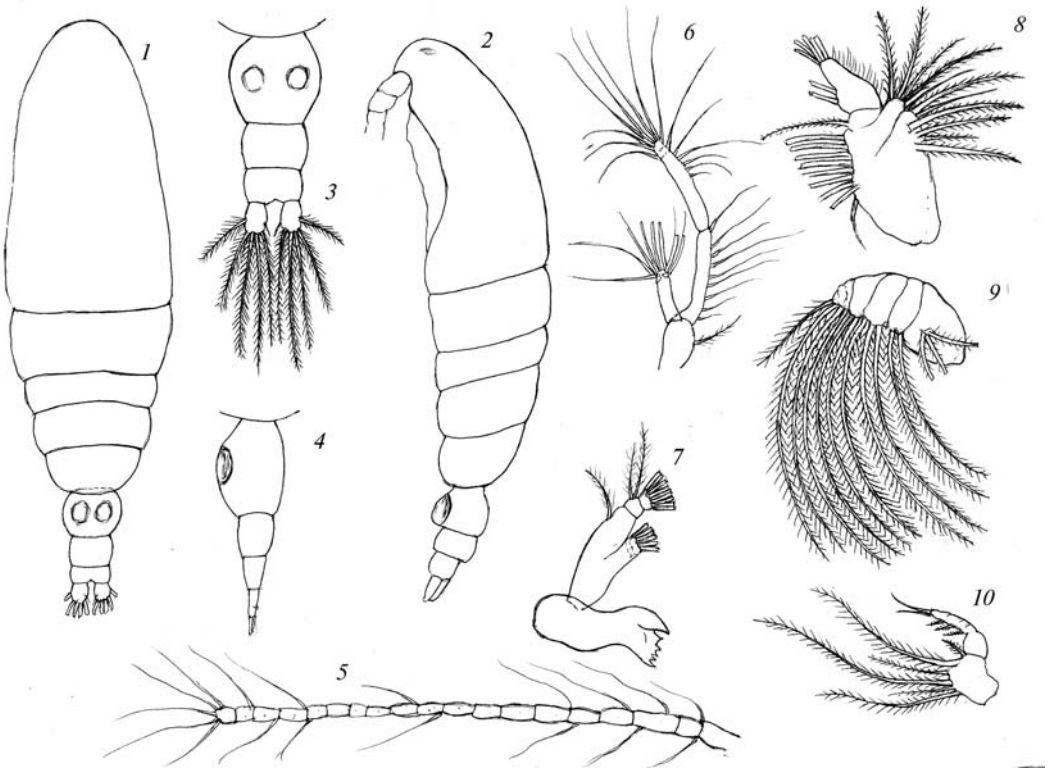

Fig. 4. *Acartia eremeevi* sp. n., ♀: *1* — dorsal view of whole specimen; *2* — lateral view whole specimen; *3* — urosome, dorsal view; *4* — urosome lateral view; *5* — antennula; *6* — antenne; *7* — mandible; *8* — maxilulle; *9* — maxilla; *10* — maxilliped.

Рис. 4. *Acartia eremeevi* sp. n. ♀: *1* — общий вид, дорсально; *2* — общий вид, латерально; *3* — уросома, дорзально; *4* — уросома латерально; *5* — антеннула; *6* — антенна; *7* — мандибула; *8* — максиллула; *9* — максилла; *10* — максиллипеда.

Swimming legs (fig. 5, *1–4*) delicate, with 3-segmented exopod and 2-segmented endopod, coxa unarmoured, basis also without setae except for leg 4, outer distal corners of exopod segments, legs 2–4 pronounced and pointed. Fifth leg (fig. 5, *5*) symmetrical, second segment 1.5 times as long as wide with a short plumose seta at outer side. Legs elongated, basal segment fused medially. The terminal spine narrow, bare, shorter than 2nd segment, without dental inner and outer ends. Marginal seta longer than terminal spine.

Male (fig. 6, *1–5*). Length 0.70–0.75 (mean 0.73). Body elongated. Metasome as pointed as in females, without lateral and dorsal spines (fig. 6, *1, 2*). Prosome/urosome ratio = 3 : 1 : 1. Posterior corners of 5 pediger naked, urosome segments usually unarmoured (fig. 6, *3*). Urosome segments to caudal rami proportion — 11 : 29 : 23 : 8 : 12 : 17 = 100. Right antennula 19-segmented (fig. 6, *4*). Other mouthparts and swimming legs 1–4 as in female copepods. Prosome to urosome ratio 74.2 : 25.8; urosome 5-segmented, first three segments without lateral and dorsal spines and filaments. 4th segment of urosome smaller in size. Caudal rami about twice as long as wide, armoured with five setae each. Right basis of fifth leg armoured with outer seta and distolateral corner, and 3-segmented exopod. First exopodal segment elongated, with one seta at distal part; second with two little spines on proximal and distal edges of inner lobe and with one outer spine. Third segment very long and curved, with one internal and two external spines, without a large terminal spine. The left basis armoured with outer seta and one conic spine at inner border, and 2-segmented exopod; distal exopod with small

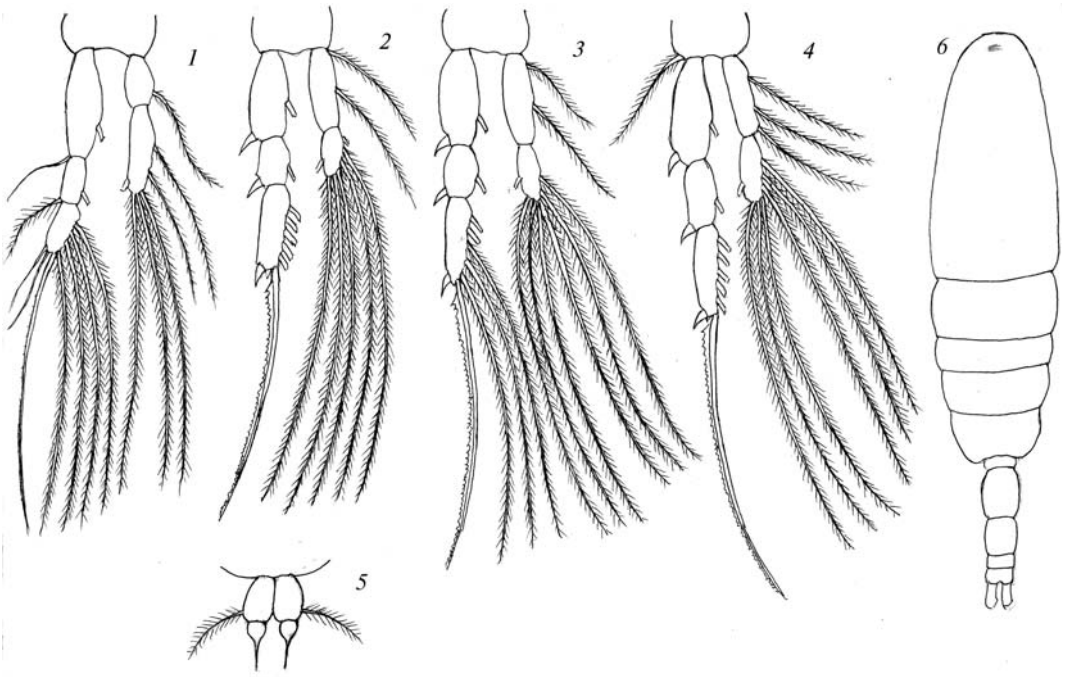

Fig. 5. *Acartia eremeevi* sp. n., ♀: *1* — first swimming leg; *2* — second swimming leg; *3* — third swimming leg; *4* — fourth swimming leg; *5* — fifth legs.

Рис. 5. *Acartia eremeevi* sp. n., ♀: *1* — первая плавательная нога; *2* — вторая плавательная нога; *3* — третья плавательная нога; *4* — четвертая плавательная нога; *5* — пятая плавательная нога.

spine and little setule along distal inner border, and finger-shaped appendage covered with small spines. Inner margin with small basal setulae. Third segment of fifth leg with two integumental pores, armoured with outer terminal spines, and claw curved inwards (fig. 6, *5*).

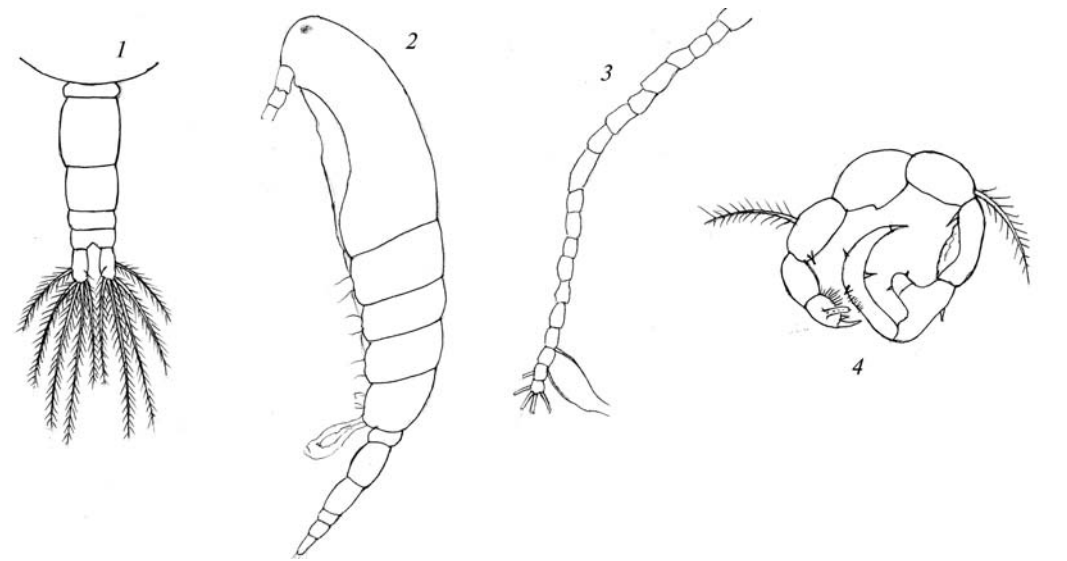

Fig. 6. *Acartia eremeevi* sp. n., ♂: *1* — dorsal view of whole specimen; *2* — lateral view whole specimen; *3* — urosome, dorsal view; *4* — right antennula; *5* — fifth leg.

Рис. 6. *Acartia eremeevi* sp. n., ♂: *1* — общий вид, дорсально; *2* — общий вид, латерально; *3* — уросома, дорзально; *4* — правая антеннула; *5* — пятая нога.

Etymology. The species is named after academician V. N. Eremeev, Director of the Institute of Biology of the Southern Seas, National Academy of Sciences of Ukraine, who has significantly contributed to investigation of zooplankton of the Black Sea.

Remarks. The new species were compared with other similar copepods known from the Black Sea. The new copepods differ by the structure of the fifth legs in female specimens. Female *A. mollicula* sp. n. do has no setae on the posterior surface, whereas *A. eremeevi* has setae on the proximal segment of the fifth leg (tabl. 2).

Distribution. The two new species, *A. mollicula* and *A. eremeevi*, occur in the Black Sea (Shmeleva et. al., 2008; Shmeleva et al., 2009), the Marmara (Unal et. al., 2000), Red, and Levantine Sea, in coastal sea water of different salinity and temperature. They have been recorded under the names *Acartia* sp., *Acartia* sp. 1, and *Acartia* sp. 2, correspondingly.

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