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A new species of *Schizopera* Sars, 1906 (Copepoda: Harpacticoida) from Israel

by Süphan Karaytuğ and Serdar Sak

Abstract. Both sexes of *Schizopera samchunensis* n. sp. (Copepoda: Harpacticoida: Diosaccidae) are described from the Hula valley in Israel with the aid of light and electron (SEM) microscopes. The differences between the new species and the morphologically similar species *S. compacta* and *S. taricheana* are discussed.

Kurzfassung. Aus dem Hula-Tal in Israel werden beide Geschlechter von *Schizopera samchunensis* n. sp. (Copepoda: Harpacticoida: Diosaccidae) mit Hilfe von Licht- und Elektronenmikroskopie beschrieben. Die Unterschiede zwischen der neu gefundenen Art und den morphologisch sehr ähnlichen Arten *S. compacta* und *S. taricheana* werden diskutiert.

Key words: Copepoda, taxonomy, Hula Valley, *Schizopera samchunensis* n. sp.

Introduction

The family Diosaccidae contains about 389 species and subspecies distributed among 44 genera (KARANOVIC & RANGA REDDY 2004). *Schizopera* Sars, 1905 is one of the most speciose genera within the family and comprises over 80 species and subspecies (MIELKE 1995, BODIN 1997, KARANOVIC 2004). APOSTOLOV (1982) divided the genus *Schizopera* into three genera: *Schizopera* (with two subgenera: *Schizopera* s. str. and *Neoschizopera*); *Eoschizopera* Wells & Rao, 1976 (with two subgenera: *Eoschizopera* s. str. and *Praeoschizopera*); and *Schizoperopsis* Apostolov, 1982 (with two subgenera: *Schizoperopsis* s. str. and *Psammoschizoperopsis*). These groupings have been rejected by some authors (MIELKE 1992, BODIN 1997, KARANOVIC 2004).

The most important autapomorphy for *Schizopera* is the presence of a hyaline spine on the distal segment of P3 exopod (male). However, the position of many species within the genus and its subgenera is doubtful (HUYS 1995, KARANOVIC 2004) since the descriptions of many species are inadequate for evaluating the monophyletic status of these groupings and this autapomorphic character is not given or mentioned in the descriptions. The monophyly of the genus must be established by a complete systematic revision. Many recent taxonomic studies of harpacticoid copepods have confirmed that a detailed description of the species is essential for discriminating between closely related species (CLEMENT & MOORE 1995, HUYS & CONROY-DALTON 1996) and this is also indispensable for the definition of generic boundaries (HUYS 1992, KARAYTUĞ & HUYS 2004).

Material and methods

Specimens were dissected in lactic acid and the dissected parts were mounted on slides in lactophenol mounting medium. Supporting broken glass-fibres were added to prevent the animal and

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appendages from being compressed by the coverslip and to facilitate rotation and manipulation, allowing observation from all angles. Preparations were sealed with Entellan (Merck). 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 and SEM micrographs are in µm.

The material was examined with a Zeiss Leo 1430 scanning electron microscope. Specimens were prepared by dehydration through graded acetone, critical point dried, mounted on stubs and sputter-coated with gold and palladium.

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) for the proximal (middle, distal) segment of a ramus.

Results

Family DIOSACCIDAE Sars, 1906

Genus *Schizopera* Sars, 1905, Subgenus *Schizopera* s. str. Sars, 1905

Schizopera (*S.*) *samchunensis* n. sp. (Figs. 1-8)

Material: Specimens are deposited in Balıkesir University (BU), Zoology Department, and the Section of Aquatic Invertebrates, Biological Collections, The Hebrew University (HU) of Jerusalem. Holotype adult ♀ dissected on 8 slides (deposited in HU). Paratypes are 2 adult ♀ dissected on 9 slides and 1 adult ♂ dissected on 7 slides (deposited in BU). Preserved in alcohol are 5 adult ♀ and 2 adult ♂ collected on 19 March 2003 (deposited in HU). Five adult ♀ and 2 adult ♂ collected on 25 April 2003 (deposited in BU). Leg. Chanan DIMENTMAN. Materials collected from a spring on the border of the Hula Valley and lower slopes of the Golan Heights (33°11'N, 35°39'E).

Diagnosis: Posterior margin of urosomal somites with plain hyaline frill. Free abdominal somites with transverse spinular rows dorsally and ventrally (Figs. 1A, 2A). Caudal rami (Fig. 1A, C) with a long group of a spinular row along the inner margin. P1 (Fig. 5A) enp-1 slightly exceeding the exopod. P5 (Fig. 2A) endopodal lobe and exopod with 4 spines and 6 setae respectively and exopod partially fused to baseoendopod anteriorly. P1 of male (Fig. 5E) with a thick spiniform chitinous formation on inner edge. P5 exopod of male (Fig. 2B) with 5 setae.

Description (female): Total body length from tip of the rostrum to the posterior margin of the caudal rami: 448-559 µm (mean = 509 µm; n = 10). Body width: 100-120 µm (mean = 110 µm; n = 10). Body (Fig. 1A-B) more or less cylindrical, gradually tapering posteriorly. P1-bearing somite completely incorporated in cephalosome, forming a cephalothorax. Integument of somites with transverse rows of minute spinules as figured (Fig. 1A-B). Posterior margin of urosomal somites with plain hyaline frill. Sensillar pattern as figured (Figs. 1A, 2A). Rostrum (Figs. 1A, 4A, 8C) large and elongate, exceeding half of the second antennular segment and with 2 delicate sensillae.

Genital somite (Figs. 1A, 2A) wider than long. Rows of tiny spinules present dorsally. Genital field as figured (Fig. 3F); copulatory pore large, leading to a wide copulatory duct; seminal receptacles separated from each other. Sixth leg represented by one pinnate spine and a long naked seta (Fig. 3F). Free abdominal somites with transverse spinular rows dorsally and ventrally (Figs. 1A, 2A). Third abdominal somite with pseudoperculum projecting

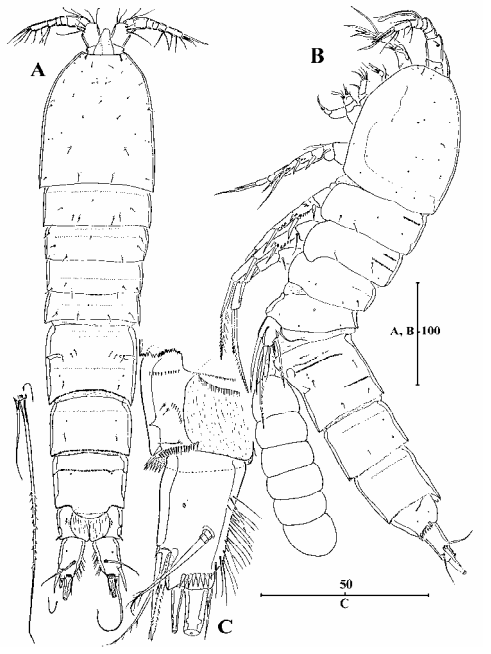

Fig. 1. *Schizopera samchunensis* n. sp. (♀) A, Habitus, dorsal; B, Habitus, lateral; C, Anal somite and left caudal rami, dorsal.

dorsally on to rounded anal operculum. Anal somite with rows of minute spinules near anal operculum as figured (Figs. 1C, 8A).

Caudal rami (Fig. 1A, C) about twice as long as wide; with a pore located midway along the dorsal side and with a long group of a spinular row along the inner margin; furnished with 6 setae: seta I absent; seta II plumose; seta III spiniform, bearing a flagellum near the tip; setae IV and V well developed; seta VI short and bare, concealed by seta V; seta VII plumose and triarticulate at the base.

Antennule (Fig. 4A) short, 8-segmented; with outer sclerite at base of segment 1. Segment 1 short with spinules posteriorly and with a long naked seta near anterodistal margin. Segment 2 longest, about one and a half times as long as wide. Armature formula: 1-[1], 2-[9], 3-[6], 4-[1 + (1 + ae], 5-[2], 6-[4], 7-[3], 8-[5 + acrothek].

Antenna (Fig. 4C) comprising coxa, allobasis and 1-segmented rami. Coxa small and with spinules near inner margin. Allobasis with a partial suture line along midway, and with spinular rows near base of exopod and at outer margin; abexopodal seta unipinnate. Exopod 2-segmented; segment 1 with unipinnate seta at distal corner, segment 2 with naked seta at distal margin and bipinnate spine bearing spinules at the base. Free endopod 2 with rows of coarse spinules on lateral margin and finer spinules at inner distal corner; lateral armature consisting of 2 unipinnate spines bearing flagellum near the tip and 2 fine setae fused at the base; apical armature consisting of 1 spine bearing flagellum near the tip, 4 geniculate setae (largest spiniform, with large spinules proximal to geniculation), 1 unipinnate seta and 1 naked seta.

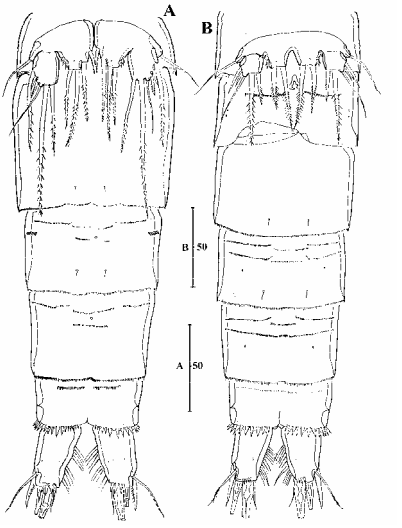

Fig. 2. *Schizopera samchunensis* n. sp. A, Urosome ♀, ventral; B, Urosome ♂, ventral.

Mandible (Fig. 3E). Coxa elongate, forming a gnathobase provided with series of multicuspidate teeth distally and unipinnate seta at dorsal corner, with a protuberance near dorsal corner. Palp biramous (see insertion in Fig. 3E), consisting of basis and 1-segmented rami. Basis with 3 spinular rows and 3 setae (2 plumose and 1 naked). Exopod distinctly smaller than endopod; with 1 bare seta. Endopod long; lateral armature consisting of 2 naked setae; distal armature consisting of 5 naked setae.

Maxillule (Fig. 3A). Praecoxal arthrite with 2 tube setae on anterior surface, with 9 elements around distal margin and with 3 long spinules at inner margin. Coxal endite cylindrical with 1 seta and 1 unipinnate curved spine. Basis (see insertion in Fig. 3A) with 5 naked setae and 2 bipinnate setae, bearing spinular row at the outer distal corner. Exopod smaller than endopod; with 1 naked seta and 1 unipinnate seta. Endopod elongate; with 3 naked setae.

Maxilla (Fig. 3D) comprising syncoxa and allobasis. Syncoxa with 3 endites; proximal endite with 1 unipinnate seta and 1 naked seta; middle endite with 2 unipinnate spines and distal endite with 3 unipinnate spines. Allobasis drawn out into bare claw; accessory armature consisting of 2 naked setae and 1 bipinnate spine. Endopod 2-segmented (see insertion in Fig. 3D); enp-1 with 2 naked setae and enp-2 with 2 naked setae.

Maxilliped (Fig. 3B) subchelate, comprising syncoxa, basis and 1-segmented endopod. Syncoxa armed with 2 spinular rows and 3 strong unipinnate spines at distal inner corner. Basis with 2 surface spinular rows and with short bare seta. Area between basis and endopod with a large sclerite surrounded by membrane (Fig. 3C). Endopod drawn out into a strong, slightly curved unipinnate claw, well defined at base and with 2 long and 1 minute setae.

P1 (Fig. 5A). Intercoxal sclerite without ornamentation. Praecoxa represented by a well developed sclerite. Coxa with spinular rows on anterior surface as figured. Basis much narrower than coxa, anterior surface with secretory pore near the base of outer spine and various spinular rows as figured; outer and inner spines bipinnate, inner spine located midway along the inner margin. Rami 3-segmented. Exopod segments with coarse spinules along outer

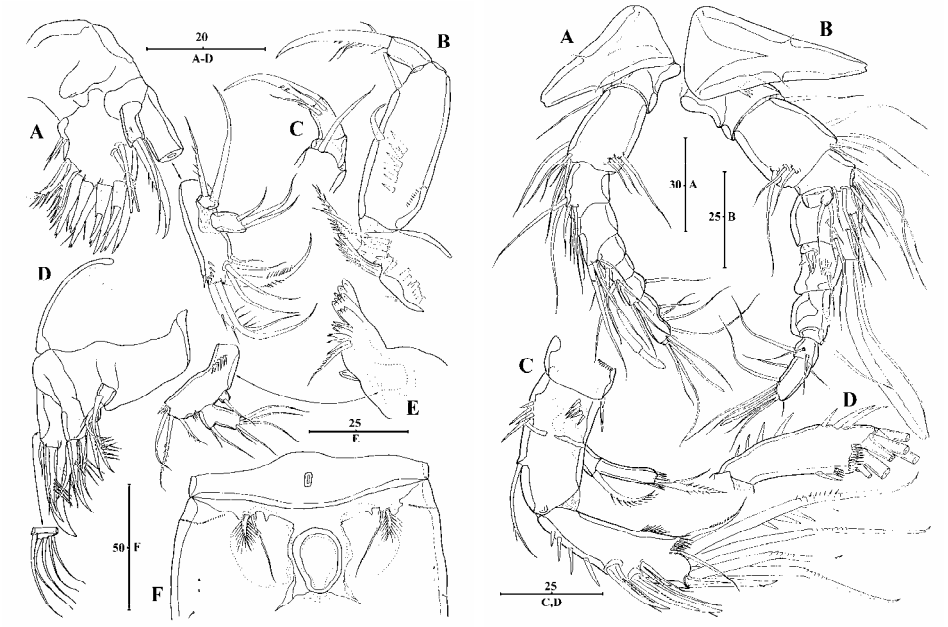

Fig. 3 (left). *Schizopera samchunensis* n. sp. (♀) A, Maxillule, posterior [insertion showing the palp]; B-C Maxilliped; D, Maxilla [insertion showing endopod]; E, Mandible [insertion showing mandibular palp]; F, Genital field and sixth legs, ventral. – Fig. 4 (right). *Schizopera samchunensis* n. sp. A, Rostrum and proximal segments of left antennule ♀, dorsal; B, Rostrum and proximal segments of right antennule ♂, dorsal; C, Antenna ♀, outer lateral; D, Antennary endopod ♀, medial.

margin, inner margin of second segment with spinules; exp1-2 with strong bipinnate spines; exp-3 with 3 geniculate spines and long unipinnate seta. Endopod much longer than exopod, prehensile; enp-1 slightly exceeding the exopod and with spinules along inner and outer margins; enp-2 without seta and with 2 fine setules near outer distal corner and a large spinule near outer distal corner; exp-3 with 2 strong geniculate setae and 1 small unipinnate seta, and with 2 strong spinules near outer distal corner.

P2-P4 (Figs. 5B, 6A, C) with 3-segmented endopod and exopod. Intercoxal sclerites with spinous protuberances at distal corners and without spinular row. Praecoxa represented by a well developed sclerite with a spinular row on anterior surface. Coxa with spinular rows anteriorly as figured. Bases with spinular row near the insertion of exopod. Exopod and endopod segments with coarse spinules along outer margin. Basis with outer bipinnate spine (P2) or plumose setae (P3-P4). Enp 1 without inner seta (P2). Spine and seta formula as follows:

	Exopod	Endopod
P1	0.0.022	1.0.111
P2	0.1.022	0.1.121
P3	0.1.022	1.1.121
P4	0.1.022	1.1.021

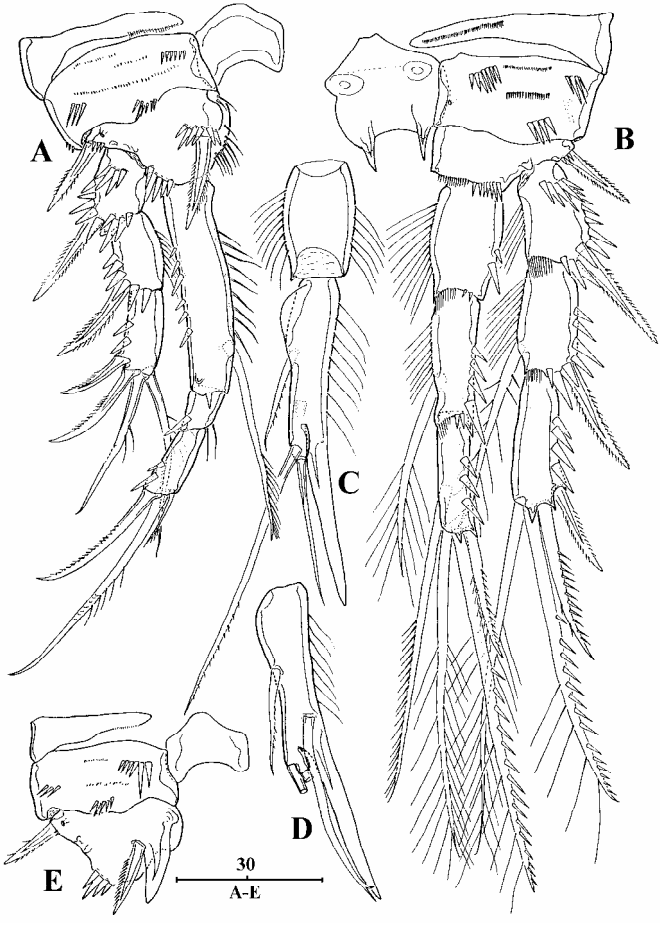

Fig. 5. *Schizopera samchunensis* n. sp. A, P1 ♀, anterior; B, P2 ♀, anterior; C, P2 endopod ♂, anterior; D, P2 endopod ♂, posterior; E, P1 ♂, anterior.

P5 (Fig. 2A) biramous. Baseoendopod with outer basal seta. Endopodal lobe extending almost to middle of exopod; inner margin with small spinules; with 3 bipinnate setae arranged around distal margin and with inner unipinnate spine. Exopod partially fused to baseoendopod anteriorly (Fig. 8B) but separated posteriorly (Fig. 2A); with 3 setae arranged around distal margin (inner and middle setae bipinnate, outer one naked, middle seta almost twice as long as the inner one), outer margin with proximal unipinnate seta and 2 unipinnate spines.

Male: Total body length from tip of the rostrum to the posterior margin of the caudal rami: 370-489 μm (mean = 445 μm; n = 4). Body width: 97-102 μm (mean = 98 μm; n = 4). Sexual dimorphism in antennule, P1, P2, P3, P5, P6.

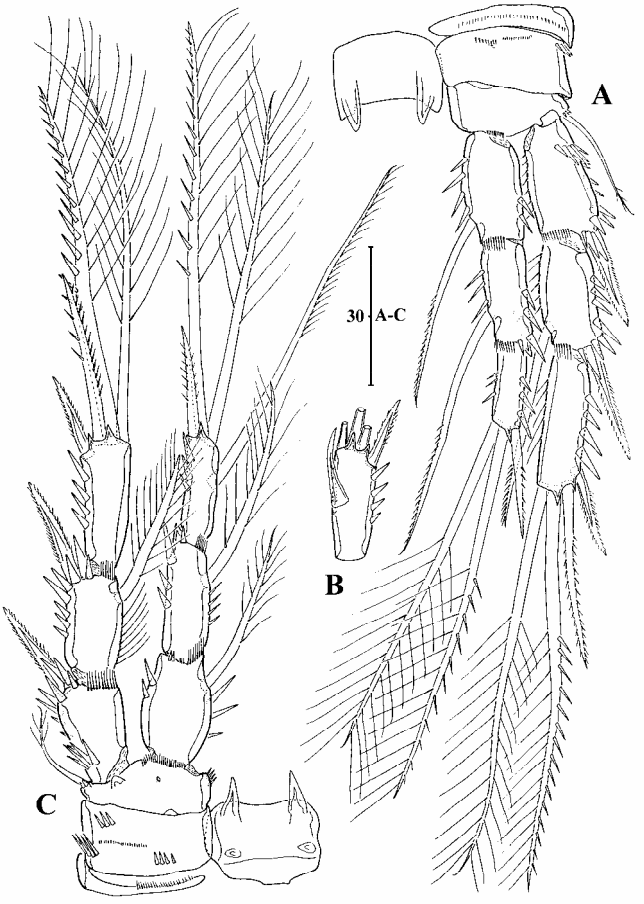

Fig. 6. *Schizopera samchunensis* n. sp. A, P4 ♀, anterior; B, P3 exp 3 ♂, anterior; C, P3 ♀, anterior.

Antennule (Figs. 4B, 7A-B) haplocer and 9-segmented. Segment 1 with a small sclerite at proximal posterior corner. Segment 4 small and with 2 naked setae. Segment 5 swollen, forming lobate expansion anteriorly; with large aesthetasc arising from pedestal and fused basally to long slender seta. Segment 6 with 4 modified spines and a seta. Segment 7 with a modified spine and with naked seta. Armature formula 1-[1], 2-[8], 3-[8], 4-[2], 5-[6+ (1 + ae)], 6-[1 + 4 modified)], 7-[1 + 1 modified], 8-[4], 9-[5 + acrothek]. Acrothek consisting of short aesthetasc fused basally to 2 bare setae.

P1 (Fig. 5E) as in female except for basis with a thick spiniform chitinous formation on inner edge. P2 (Fig. 5C) as in female except for 2-segmented endopod; second endopodal segment derived from second and third endopodal segments of the female; with 1 inner unipinnate seta at inner margin and 1 naked seta with forked tip near distal margin on posterior surface (Fig. 5D), distal margin with 1 long unipinnate seta and 1 naked seta articulating

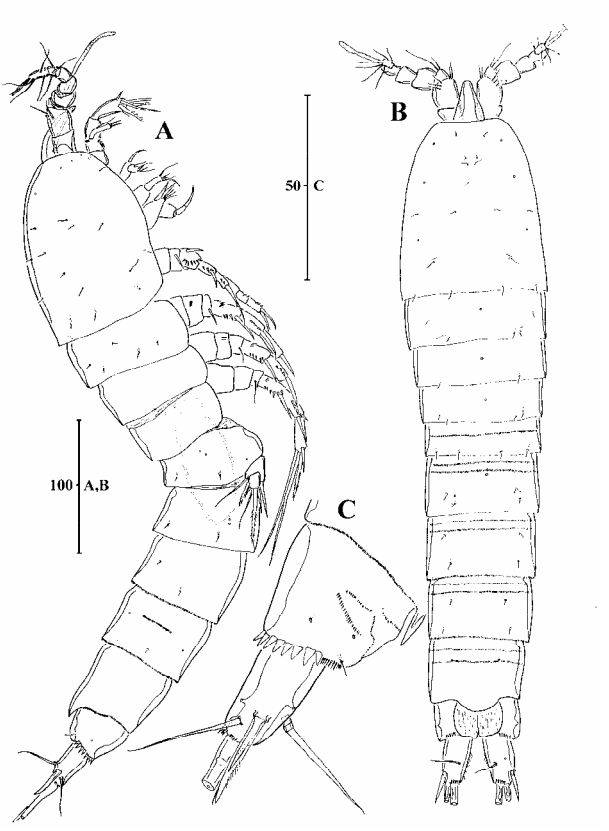

Fig. 7. *Schizopera samchunensis* n. sp. (♂) A, Habitus, lateral; B, Habitus, dorsal; C, anal somite and caudal rami, lateral.

at base (Fig. 5C), and a strong spine fused at base (Fig. 5D). P3 (Fig. 6B) as in female except for exp 3 with a hyaline, broad spine at inner margin (arrowed in Fig. 6B).

Fifth legs (Fig. 2B) medially fused; endopodal lobe slightly shorter than exopod and with 2 bipinnate spines arranged at distal margin. Exopod free; with 5 setae. Sixth legs (Figs. 2B; 8D) asymmetrical, fused to somite. Operculum closing off functional gonopore (arrowed in Fig. 8D).

Etymology: The species name refers to the ancient name "samchuna" for Lake Hula (Israel).

Discussion

Schizopera (S.) samchunensis n. sp. can be differentiated from other *Schizopera* species by the combination of the following characters; in the female by the structure of P5 (the presence of six setae on the exopod, especially the partial fusion of the exopod to the baseoendopod), by the length of the rostrum, by the presence of an inner seta on the first segment of the

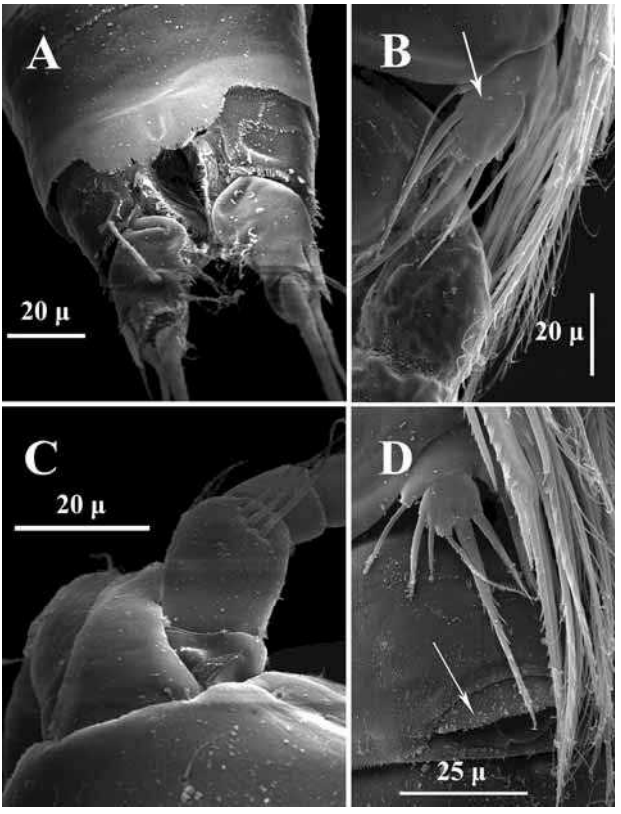

Fig. 8. *Schizopera samchunensis* n. sp. SEM micrographs (♀) A, Anal somite and caudal rami, dorsal; B, P5 ♀, lateral [arrow indicates partial fusion of the exopod]; C, Cephalothorax, dorsal, showing rostrum and proximal segments of the antennule ♀; D, P5 and sixth leg ♂, ventral [functional gonopore arrowed].

endopod of P3 and P4, by the presence of fine hairs along the inner margins of the caudal rami and by the convergent caudal rami.

The new species is morphologically most similar to *S. compacta* Lint, 1922 and *S. taricheana* Por, 1968 but it differs from *S. compacta* by the structure of P5 and by the longer caudal rami. *S. taricheana* was described from Israel (POR 1968) and examination of the types of *S. taricheana* deposited in the Hebrew University confirmed that the slides are not in good condition and that the female endopod is missing on the slides (D. POR, pers. comm.). On the other hand, the middle segment of the male P4 endopod has an inner seta. An attempt was made to collect fresh material of *S. taricheana* from the terra typica, but no specimen was found (Ch. DIMENTMAN, Hebrew University, pers. comm.). However, the type slides are good enough to confirm the presence of six setae on the exopod of P5 which separates the new species from *S. taricheana*. An additional character distinguishing the new species from *S. taricheana* is the shorter rostrum (reaching only middle of the second antennule segment), which is longer in *S. taricheana* (exceeding the second segment of the antennule).

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