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A NEW DEEP-SEA GENUS AND SPECIES OF THE FAMILY  
ASTEROCHERIDAE (COPEPODA, SIPHONOSTOMATOIDA) FROM THE  
CONTINENTAL MARGIN OFF ANGOLA (EAST EQUATORIAL ATLANTIC)

BY

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ABSTRACT

*Gerulososacculus commutabilis*, a new genus and species of the family Asterocheridae Giesbrecht, 1899 (Copepoda: Siphonostomatoida) is described, based on specimens collected with a bottom trawl from the continental margin off equatorial Africa (Angola) at a depth of 1288-1289 m. The new genus is added to a group of 9 genera of asterocherids (*Australomyzon* Nicholls, 1944; *Bythocheres* Humes, 1988; *Cheramomyzon* Humes, 1989; *Collocheres* Canu, 1893; *Collocherides* Stock, 1971; *Dermatomyzon* Claus, 1889; *Glyptocheres* Humes, 1987; *Ophiurocheres* Humes, 1998; *Rhynchomyzon* Giesbrecht, 1895), which is distinguished by the 5-segmented urosome in the female and the 6-segmented urosome in the male. *Gerulososacculus* differs from all other genera in this group in having an elongate body, a dorso-ventrally flattened prosome, the genital somite of female and male 2.3 times as wide as long, the rostrum with a broad edge, the terminal claw of the antenna and of the maxilliped divided into two parts by a transverse suture, the swimming legs 1-4 with slender setae bearing short setules, the lobe-like leg 5, and the elongate caudal rami. The variability and the asymmetry of the armature of the swimming legs 2-4 are additional remarkable features of *G. commutabilis*.

RÉSUMÉ

*Gerulososacculus commutabilis*, une espèce nouvelle d'un genre nouveau, de la famille des Asterocheridae Giesbrecht, 1899 (Copepoda, Siphonostomatoida) est décrite, à partir de femelles et mâles récoltés à l'aide d'un chalut, au large de l'Afrique équatoriale (Angola) à la profondeur de 1288-1289 m. Le nouveau genre s'ajoute à un groupe de 9 genres (*Australomyzon* Nicholls, 1944; *Bythocheres* Humes, 1988; *Cheramomyzon* Humes, 1989; *Collocheres* Canu, 1893; *Collocherides* Stock, 1971; *Dermatomyzon* Claus, 1889; *Glyptocheres* Humes, 1987; *Ophiurocheres* Humes, 1998; *Rhynchomyzon* Giesbrecht, 1895) qui se distinguent par l'urosome de la femelle à 5 somites et

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l'urosome du mâle à 6 somites. *Gerulusosacculus* diffère de tous les genres de ce groupe en possédant un corps allongé, un prosome aplati dorso-ventralement, le somite génital chez la femelle et le mâle 2,3 fois plus large que long, un rostre à bord large, la griffe terminale de l'antenne et du maxillipède divisé en deux parties, les pattes 1-4 pourvues de soies grêles portant de courtes sétules, une P5 en forme de lobe et de longues rames furcales. La variabilité notable et l'asymétrie de l'armature des pattes natatoires 2-4 constituent un caractère remarquable de *G. commutabilis*.

## INTRODUCTION

The Asterocheridae form a family of siphonostomatoid copepods, that are common and abundant symbionts of bryozoans, cnidarians, echinoderms, and sponges. Most of the more than 40 genera of asterocherids inhabit shallow water, and only 5 genera are known from deep water. Four genera of asterocherids (*Cecidomyzon* Stock, 1981; *Cystomyzon* Stock, 1981; *Hammatimyzon* Stock, 1981; *Oedomyzon* Stock, 1981), representing a monophyletic group, were described from galls of stylasterine corals from the Indian Ocean (Stock, 1984; Ivanenko, 1999; Ivanenko et al., 2001). The monotypic genus *Cheramomyzon* Humes, 1989 was found in a hydrothermal vent of the East Pacific Rise (12°5'N 103°56.48'W, depth 2630 m). In addition, *Collocherides brychius* Humes, 1999 was described from bacterial mats of a deep-sea hydrothermal field at Juan de Fuca Ridge, while all its congeners are symbionts of shallow water ophiuroids (Stock, 1971; Humes, 1999). Two other deep water asterocherid-like siphonostomatoids are *Brychiopontius falcatus* Humes, 1974, from the monotypic family Brychiopontiidae Humes, 1974, associated with a holothurian found off Ireland (depth 4426-4435 m) and *Bythocheres prominulus* Humes, 1988 belonging to the monotypic genus *Bythocheres* Humes, 1988. The genus was described from bacterial mats in the West Florida Escarpment (depth 3243 and 3266 m), having uncertain family position, and was included in Asterocheridae without explanation by Boxshall & Halsey (2004).

This paper continues our exploration of the deep-sea copepods collected in the Atlantic Ocean during cruises arranged by IFREMER (Brest, France) and describes a new genus and species from the East Equatorial Atlantic (Ivanenko & Defaye, 2004; Ivanenko & Defaye, in press; Ivanenko, Defaye & Huys, submitted).

## MATERIAL AND METHODS

The copepods were found in the residue of a bottom trawl sample (sample CP 01; mesh size of 1 to 2 cm) during the cruise ZAIANGO-BIOL 2 (R/V "Thalassa"; chief scientist, Dr. Myriam Sibuet), which explored benthic communities and environment on the continental margin off equatorial Africa. The material was

sampled at depths of 1289-1288 m, and the length of the trawl track was 1920 m. The macrofauna of the sample is represented by various fishes and invertebrates (actiniarians, polychaetes, sipunculids, molluscs, crustaceans, asteroids, holothurians, ophiuroids) (J. Galeron, pers. comm.).

The copepods were studied applying, in general, the "hanging drop method" described in detail by Humes & Gooding (1964). Temporary slides were mounted using regular glass slides and coverslips attached with small balls of plasticine instead of a wooden object-plate having a centrally located hole and coverslip glued to the plate to cover the hole. The specimens were dissected on a coverslip in a small drop of lactic acid under a Leica MZ8 dissecting microscope. The dissected appendages and urosome were arranged near the edge of the drop of lactic acid one after another. Then the cover glass with the dissected copepod and small balls of plasticine attached to the corners of the glass was turned over and mounted on an object-slide, so that the appendages of the dissected copepod did not touch the object-plate. The appendages can be re-arranged under the dissecting microscope after removing and turning over the slide. All specimens or appendages were studied with a Leica DMLB compound microscope having bright-field and differential interference optics. All drawings were made with a camera lucida mounted on the compound microscope. For long-term preservation, the dissected holotype female and allotype male were mounted on slides in glycerol and sealed with Eukitt (O. Kindler GmbH & Co., Freiburg, Germany).

#### DESCRIPTION

SIPHONOSTOMATOIDA Burmeister, 1835

ASTEROCHERIDAE Giesbrecht, 1899

#### **Gerulusosacculus** n. gen.

Diagnosis. — Asterocheridae. Body elongate, flattened. Epimeral plates of metasomites well developed, rounded, and directed posteriorly. Urosome 5-segmented in female, 6-segmented in male. Genital double-somite of female with suture on ventral side separating somites; gonopores dorsolateral in anterior half of genital somite, copulatory pores ventrally under gonopores. First somite of genital double-somite of female and genital somite of male 2.3 times as wide as long. Rostrum with wide ventral prominence. Caudal rami elongate, with 6 setae. Oral siphon short and robust. Female antennule 20-segmented with aesthetasc on segment 17; 3<sup>rd</sup> segment double and subdivided anteriorly; 8<sup>th</sup> segment with 8 setae. Male antennule 18-segmented with aesthetasc on segment 17; 9<sup>th</sup> segment with 8 setae. Antenna with 1-segmented exopod bearing 3 setae and 2-segmented

endopod bearing 3 setae and claw on second segment. Mandible with stylet-like gnathobase and 1-segmented palp. Maxillule bilobed; inner lobe with 5 long setae, outer lobe with 4 setae. Maxilla 2-segmented, second segment claw-shaped. Maxilliped with unarmed basis; endopod consisting of 2 segments and stout terminal claw; first segment of endopod elongate and with 3 setae, subdivided into 3 segments on anterior side; second segment of endopod with 1 seta; claw divided in 2 parts. Swimming legs 1-4 with 3-segmented rami. Formula of armature of swimming legs 1-4 as in holotype and allotype. Formula of armature of swimming legs 2-4 variable. Leg 5 of female and male ventral, lobe-like, with 4 setae; right and left legs joined by an extended fold. Leg 6 of female represented by a dorsolateral seta; leg 6 of male by a genital flap with 2 setae.

Type species. — *G. commutabilis* n. sp. is the type species by current designation and as the only species in the genus, at the moment, by monotypy.

Host. — Unknown.

Etymology. — The generic name *Gerulusosacculus* is a combination of the Latin words “gerulus” (= messenger) and “sacculus” (= purse, little bag, little sac). The gender is masculine.

Remarks. — *Gerulusosacculus commutabilis* new genus and species, possesses a mandibular palp, an aesthetasc on one of 3 segments preceding the distal segment of the antennule, and 3-segmented rami on swimming legs 1-4. Simultaneous presence of these primitive features characterizes siphonostomatoids of the polyphyletic family Asterocheridae. The morphological characteristics of Asterocheridae, some taxonomic notes, a key to the genera, and some general comments on their biology were recently published by Boxshall & Halsey (2004). The synonymy of the two families Scottomyzontidae Ivanenko, Ferrari & Smurov, 2001 and Coralliomyzontidae Humes & Stock, 1991, with the Asterocheridae, as proposed by Boxshall & Halsey (2004) is not adopted here, as their decision was made without a proper phylogenetic analysis, and because each family has certain derived features, and may well represent different lineages of evolution in the Siphonostomatoida.

The new genus belongs to a group currently composed of 9 genera of asterocherids that is distinguished by the 5-segmented female urosome and the 6-segmented male urosome. The genera belonging to this group are: *Australomyzon* Nicholls, 1944; *Bythocheres* Humes, 1988; *Cheramomyzon* Humes, 1989; *Collocheres* Canu, 1893; *Collocherides* Stock, 1971; *Dermatomyzon* Claus, 1889; *Glyptocheres* Humes, 1987; *Ophiurocheres* Humes, 1998; and *Rhynchomyzon* Giesbrecht, 1895. *Gerulusosacculus* differs from all other genera of this group in having an elongate body, a dorso-ventrally flattened prosome, the genital somite of female and male 2.3 times as wide as long, the rostrum with a broad edge, the terminal claw of the antenna and of the maxilliped divided into two parts by a

transverse suture, the swimming legs 1-4 with slender setae bearing short setules, a lobe-like leg 5, and elongate caudal rami. The considerable variety and asymmetry of the armature of swimming legs 2-4 are additional distinguishing features of *G. commutabilis*. The fusion of two segments corresponding to the ancestral segments 3 and 4 in the female antennule of the new genus was described for two other genera of asterocherids (*Dermatomyzon* and *Scottocheres* Giesbrecht, 1897) only, and could be the result of convergent evolution (Ivanenko, 1999; Ivanenko & Ferrari, 2003).

### ***Gerulusosacculus commutabilis* n. sp. (figs. 1-5)**

Type material. — Dissected holotype ♀ (MNHN-Cp2183); dissected allotype ♂ (MNHN-Cp2184); paratypes: 2 ♀♀, 1 ♂ (MNHN-Cp2185). The type material is deposited in the Muséum national d'Histoire naturelle, Paris.

Type locality. — East Equatorial Atlantic, continental margin off Angola; 07°21.65'S-07°22.57'S 11°30.53'E-11°31.02'E; depth 1289-1288 m; 25/viii/2000; bottom trawl sample CP 01, track length 1920 m; R/V "Thalassa"; cruise: ZAIANGO-BIOL 2; principal scientist: Dr. M. Sibuet.

Etymology. — The species name is derived from the Latin word "commutabilis" (= variable, changeable) referring to the variable armature of the swimming legs 1-4. It is an adjective agreeing in gender with the (masculine) generic name.

Description. — Holotype female: body elongate and flattened (fig. 1A). Total length, excluding caudal setae, 3.33 mm; greatest width 0.93 mm. Prosome 4-segmented: cephalothorax plus 3 metasomites bearing swimming legs 2-4. Epimeral plates of metasomites well developed, rounded, and directed posteriorly. Urosome (fig. 1A, B, C) 5-segmented, comprising: first urosomite bearing leg 5, genital double-somite, 3 abdominal somites, of which last one with anal opening and caudal rami. Somite bearing leg 5 with rounded posterolateral margins. Genital double-somite with suture separating somites on ventral and lateral sides; gonopores located dorsolaterally in anterior half of the genital double-somite, copulatory pores located ventrally under gonopores. First somite of the genital double-somite 2.3 times as wide as long. Three abdominal somites with arthrodial membrane clearly visible on ventral side only. Penultimate abdominal somite short. Last abdominal somite elongate. Caudal rami (fig. 1A, D) elongate, with 6 unequal setae, one particularly long, and transverse rows of tiny setules on dorsal side (not illustrated); ratio of length to greatest width 4.5 : 1. Longest terminal seta with pointed prominences near attachment.

Rostrum (fig. 2A) a wide ventral prominence.

Egg sacs (fig. 1E) oblong.

Oral cone (fig. 2A, B) short and robust. Siphonal opening rounded, formed by labrum and labium joining laterally. Distal edge of labium ornamented with setules.

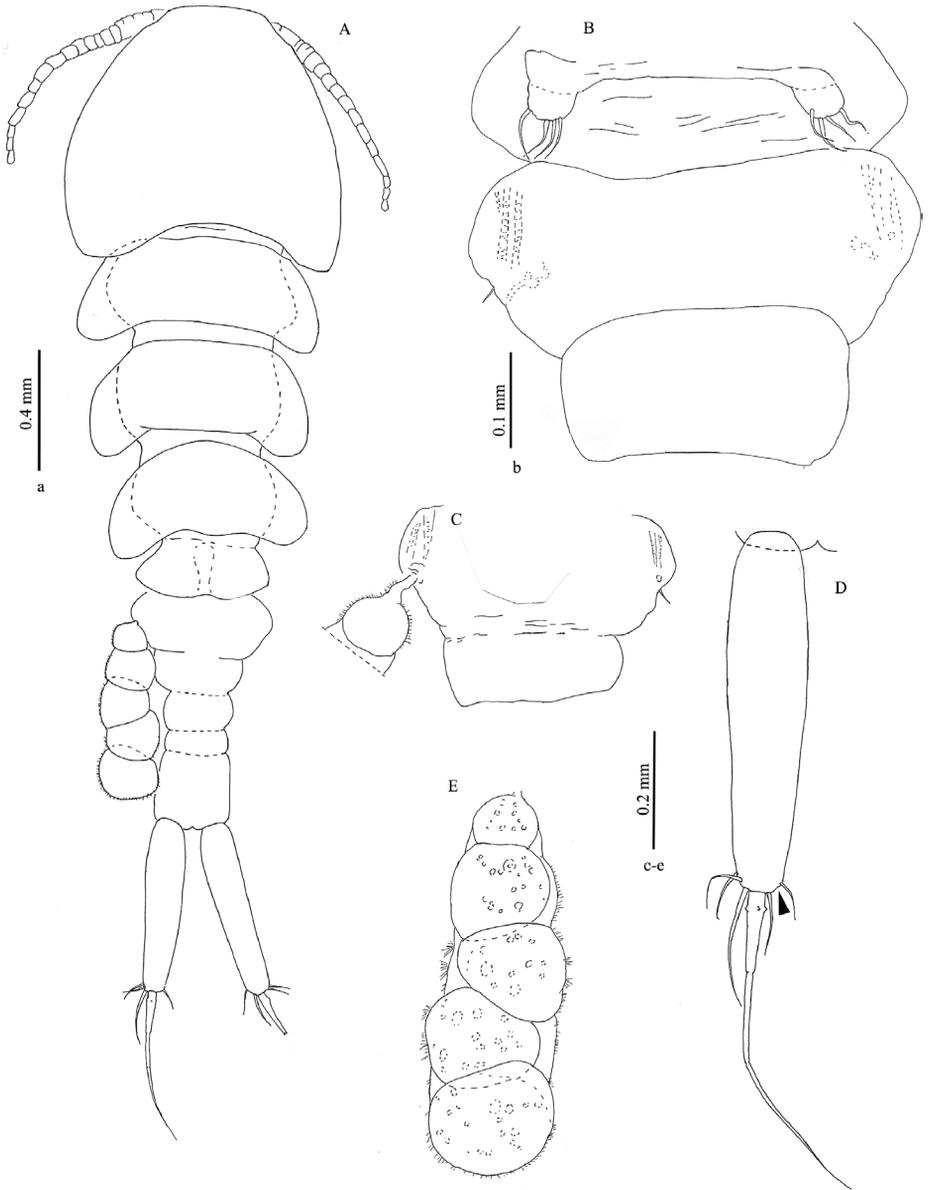


Fig. 1. *Gerulusosacculus commutabilis* n. gen., n. sp. holotype ♀: A, habitus, dorsal; B, first urosomite and genital double-somite with suture separating genital somite and first abdominal somite, ventral; C, genital double-somite, dorsal; D, caudal ramus, dorsal; E, egg sac.

Antennule (fig. 2C, D) 20-segmented. Formula of setation as follows: 1, 2, 2+2, 2, 2, 2, 2, 8, 2, 2, 2, 2, 2, 2, 2, 2+a, 2, 4, 8 (a = aesthetasc). Segment 3 double and subdivided on anterior side. Segment 8 with 8 unequal setae, 5 setae are small (fig. 2D). All setae smooth.

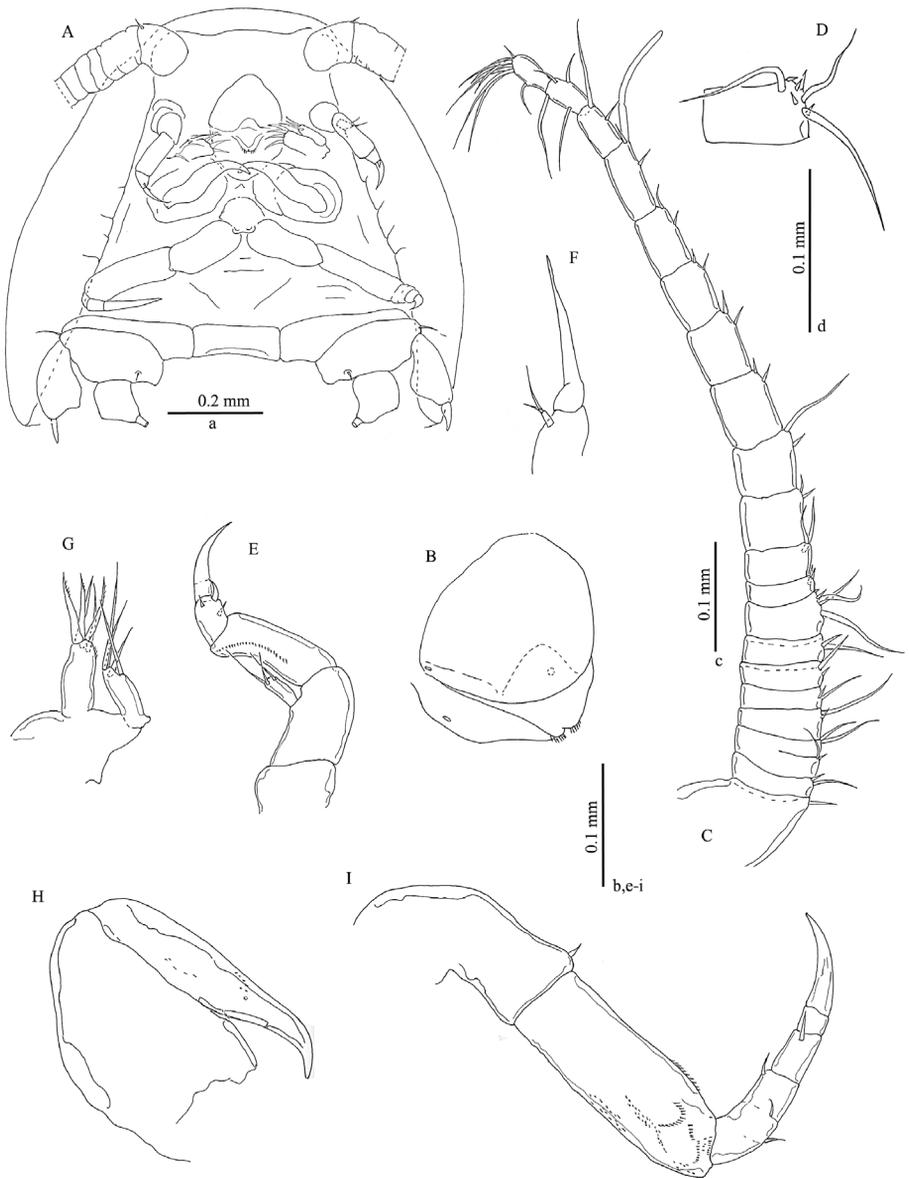


Fig. 2. *Gerulusosacculus commutabilis* n. gen., n. sp., holotype ♀: A, cephalothorax, ventral; B, oral siphon, ventrolateral; C, antennule; D, 8<sup>th</sup> segment of antennule; E, antenna; F, mandible; G, maxillule; H, maxilla; I, maxilliped.

Antenna (fig. 2E). Small coxa and elongate basis without setules. Exopod 1-segmented, armed with 1 smooth terminal seta. Endopod 2-segmented; first segment unarmed and with setules; second segment with 3 setae and terminal claw, divided in 2 parts.

TABLE I

Formulae of the armature of swimming legs 1-4, holotype ♀ of *Gerulososacculus commutabilis* n. gen., n. sp. Roman numerals indicate spines, Arabic numerals, setae. Parentheses relate to the armature state of the right leg segment when asymmetry occurs

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-1	I-1; I-1; III, 1, 3	0-1; 0-2; 1, 2, 3
Leg 2	0-0	1-0	I-1; I-1; III, I, 4	0-1; 0-2; 1, 2, 3
Leg 3	0-0	1-0	I-1; I-1; III(II), I, 4	0-1; 0-2; 1, 1, 3
Leg 4	0-0	1-0	I-0; I-1; II(III), I, 4	0-1; 0-1(2); 1, 1, 2

Mandible (fig. 2F) with tapering stylet-like gnathobase having serrated distal edge and small 1-segmented palp bearing 2 terminal setae.

Maxillule (fig. 2G) with 2 armed lobes. Inner lobe with 5 stout long setae; outer lobe articulated and with 3 terminal and 1 subterminal setae.

Maxilla (fig. 2H) 2-segmented, first segment flattened, second segment claw-shaped with blunt tip and 1 very short inner seta on proximal part.

Maxilliped (fig. 2I). Syncoxa with short inner seta. Basis unarmed, with ornamentation of short setules in the terminal half. Endopod consisting of 2 segments and a stout terminal claw. First segment of endopod elongate, partly subdivided into 3 parts on anterior side, each with a short seta. Second segment of endopod with 1 seta. Claw divided into 2 parts, a short proximal and a long distal.

Swimming legs 1-4 (figs. 3, 4) with 2-segmented protopod and 3-segmented rami. Anterior and lateral surface of rami and protopods ornamented with numerous minute epicuticular scales (not shown). Outer seta of basis smooth and appearing as divided into 2 parts. Formulae for the armature of the swimming legs in table I. Swimming leg 3: third exopodal segment with 3 (left leg) or 2 (right leg) outer spines (fig. 4A, E). Swimming leg 4: second segment of endopod with 1 (left leg) or 2 (right leg) inner setae (fig. 4B, C); third exopodal segment with 2 (left leg) or 3 (right leg) outer spines (fig. 4B, D).

Leg 5 (fig. 1B) represented by 1 lobe located on ventral side and armed with 4 setae of about same length: 3 terminal and 1 outer. Right and left lobes connected by a cuticular fold-like membrane.

Leg 6 (fig. 1B) represented by a short ventrolateral seta near gonopore.

Colour unknown.

Allotype male. — Differs from female as follows:

Body (fig. 5A): total length of allotype male excluding caudal setae: 3.24 mm, greatest width 0.87 mm. Shield of cephalothorax and tergites of metasomites clearly distinguishable. Urosome (fig. 5B) 6-segmented. Genital somite 2.3 times

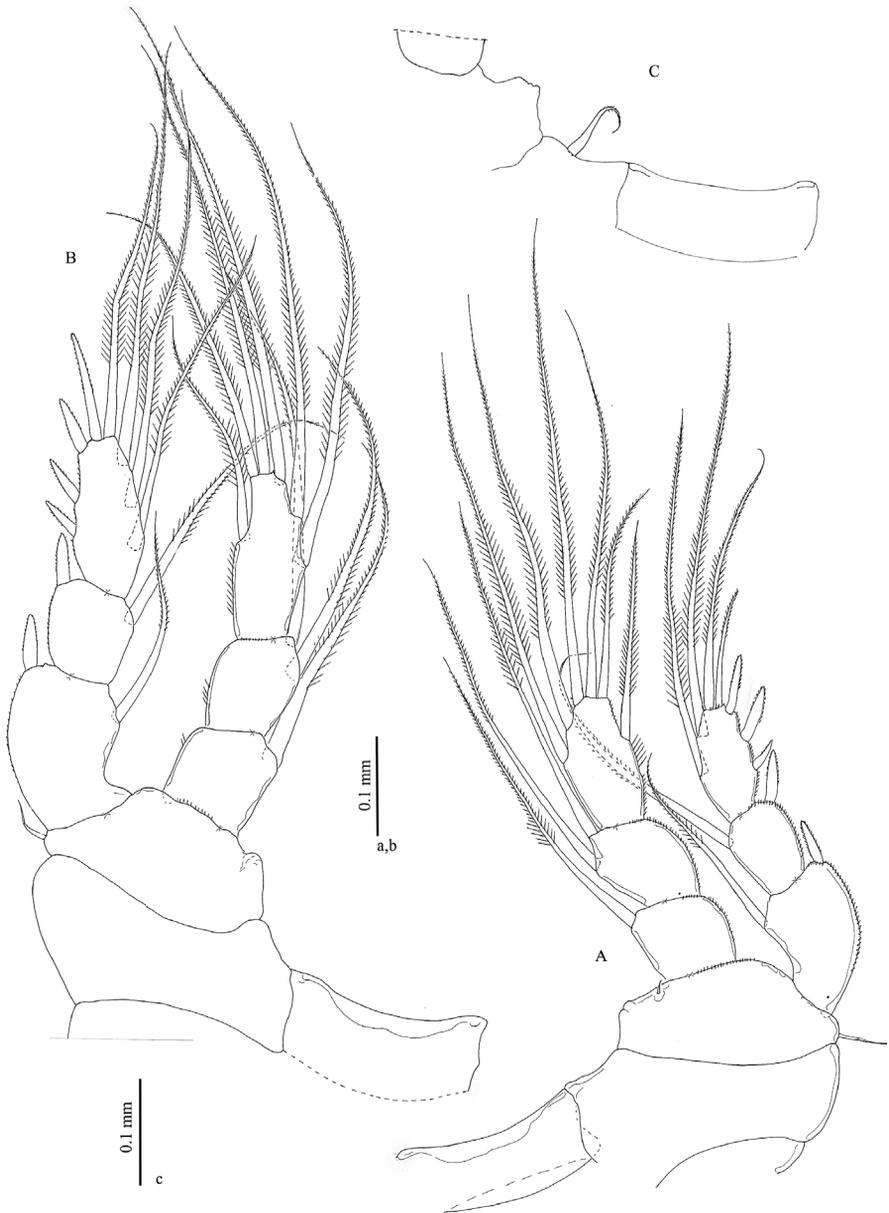


Fig. 3. *Gerulusosacculus commutabilis* n. gen., n. sp., A-B, holotype ♀: A, swimming leg 1, anterior; B, swimming leg 2, anterior. Paratype ♀ n° 2: C, inner coxal seta on left swimming leg 2.

as wide as long. First and second abdominal somites (corresponding to abdominal somite included in genital double-somite and first articulated abdominal somite of female, respectively) with arthroial membrane distinguishable on dorsal and ventral sides. Third abdominal somite short and fused with anal somite dorsally.

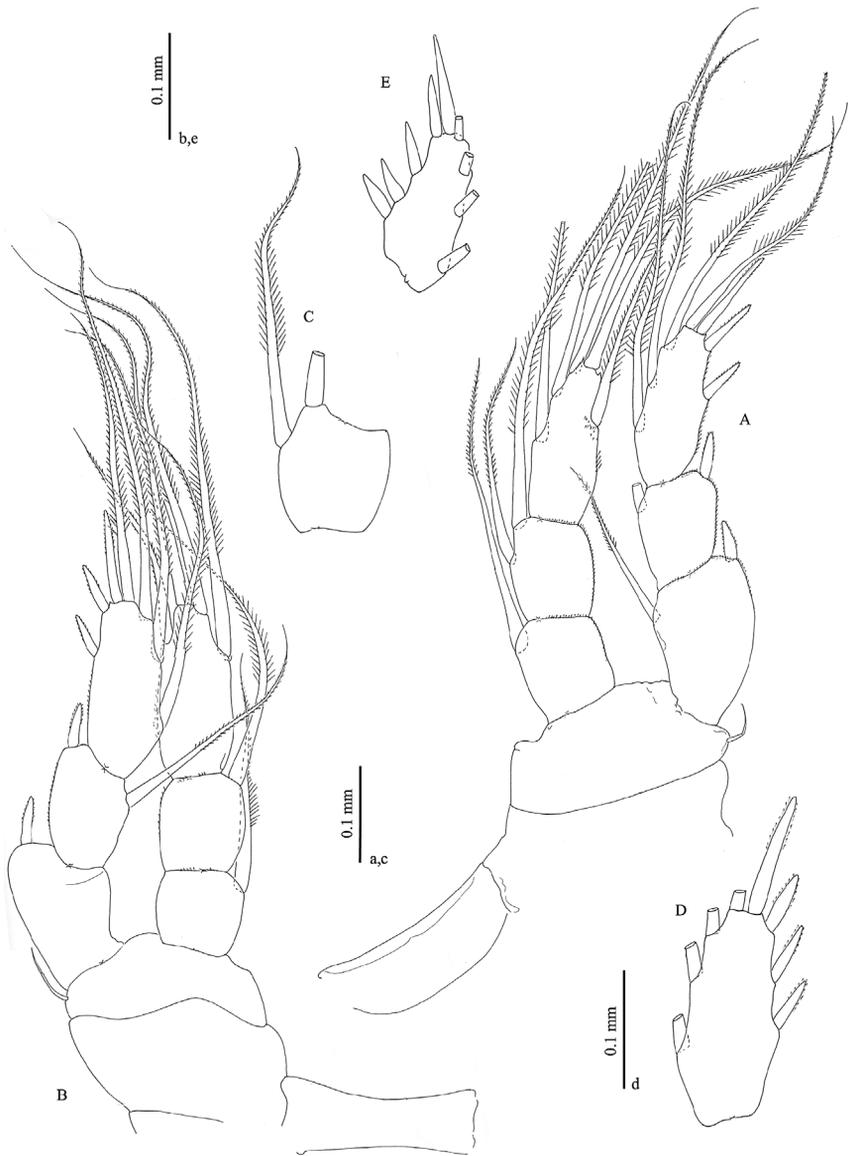


Fig. 4. *Gerulusosacculus commutabilis* n. gen., n. sp., A-D, holotype ♀: A, swimming leg 3, anterior; B, swimming leg 4, anterior; C, second segment of endopod of right swimming leg 4; D, distal segment of exopod of right swimming leg 4. Paratype ♀ n° 1: E, distal segment of exopod of left swimming leg 3.

Anal somite elongate, expanding posteriorly. Caudal rami (fig. 5A) with ratio of length to greatest width 5.3 : 1.

Antennule (fig. 5C) 18-segmented; formula of setation as follows: 1, 2, 2, 2, 2, 2, 2, 2, 8, 2, 2, 2, 2, 2, 2, 4, 4 + a, 12. Segments 3 and 4 fused on dorsal side

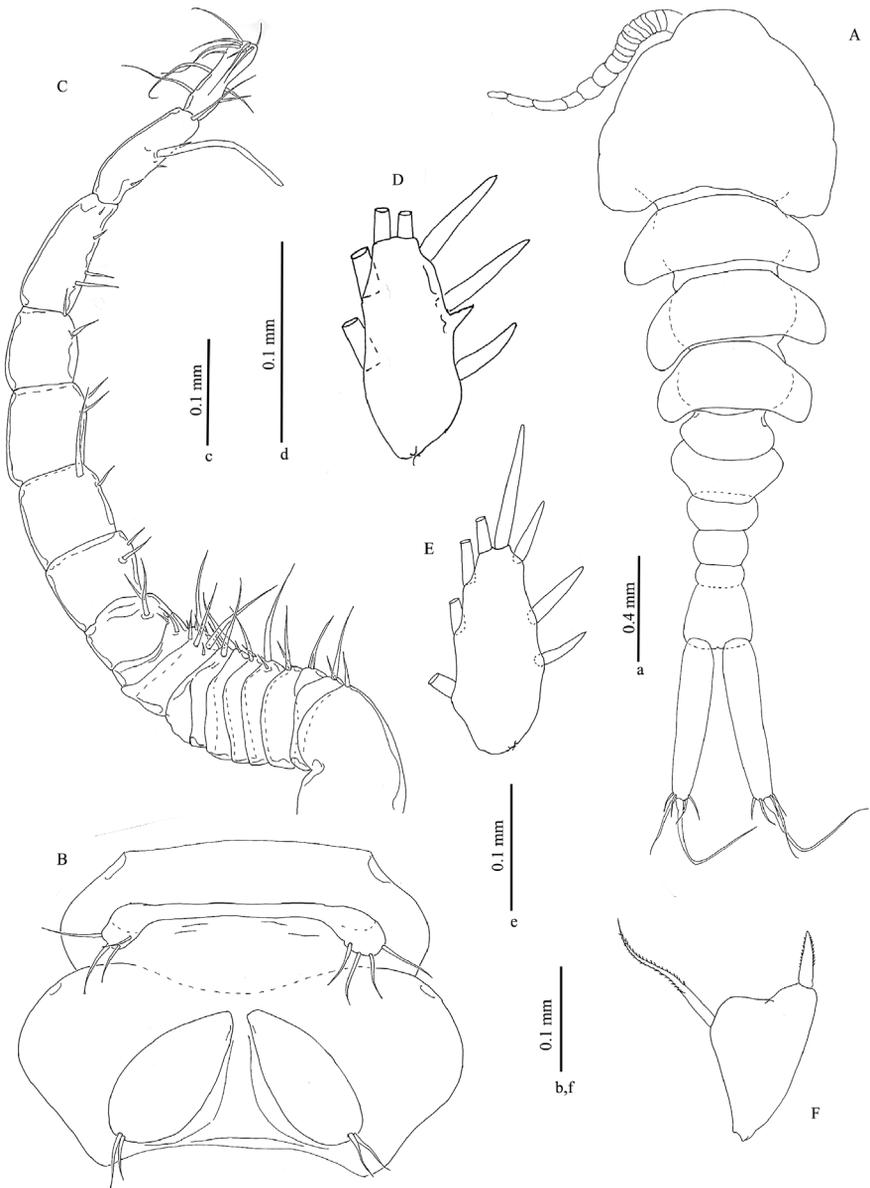


Fig. 5. *Gerulusosacculus commutabilis* n. gen., n. sp., allotype ♂: A, habitus, dorsal; B, first urosomite and genital somite, ventral; C, antennule; D, distal segment of exopod of right swimming leg 1; E, distal segment of exopod swimming leg 3; F, first segment of exopod of right swimming leg 4.

and corresponding to double (third) segment of female antennule, bearing 2 pairs of setae.

Formula of armature of swimming legs 1-4 differing from holotype female armature as shown in table II. Swimming leg 1: third segment of exopod of right leg

TABLE II

Variations in formulae of the armature of swimming legs 1-4 of the allotype ♂ of *Gerulusosacculus commutabilis* n. gen., n. sp. with regard to those of the holotype. Parentheses relate to the armature state of the right leg segment when asymmetry occurs

	Exopod	Endopod
Leg 3	I-1; I-1; III, I, 4	
Leg 4	I-0(1); I-1; III, I, 4	0-1; 0-2; 1, 1, 2

TABLE III

Variations in formulae of the armature of swimming legs 1-4 of the paratype ♀ n° 1 of *Gerulusosacculus commutabilis* n. gen., n. sp. with regard to those of the holotype. Parentheses relate to the armature state of the right leg segment when asymmetry occurs

	Exopod	Endopod
Leg 2	I-1; I-1; III(II), I, 4	0-1; 0-2(1); 1, 2, 3
Leg 3	I-1; I-1; IV(II), I, 4	
Leg 4	I-0; I-1; II, I, 4	0-1; 0-2; 1, 1, 2

TABLE IV

Variations in formulae of the armature of swimming legs 1-4 of the paratype ♀ n° 2 of *Gerulusosacculus commutabilis* n. gen., n. sp. with regard to those of the holotype. Parentheses relate to the armature state of a right leg segment when asymmetry occurs

	Coxa	Exopod	Endopod
Leg 2	0-1(0)	I-1; I-1; III(II), I, 4	
Leg 3		I-1; I-1; II, I, 4	
Leg 4		I-0; I-1(0); II, I, 4	0-1; 0-2; 1, 1, 2

with spine-like process near middle outer spine (fig. 5D). Swimming leg 3: third exopodal segment with 3 outer spines (fig. 5E). Swimming leg 4: first exopodal segment of right leg with one inner seta (fig. 5F).

Leg 5 (fig. 5B) with more distinct boundary of complex formed by legs and the connecting membrane.

Leg 6 (fig. 5B) represented by genital flap bearing 2 posterior outer setae.

Colour unknown.

Variations. — Variations in formula of the armature of swimming legs 1-4 of 2 paratype females and 1 paratype male are presented in tables III-V. Paratype female n° 1 with third exopodal segment of left swimming leg 3 with 4 outer spines (fig. 4E). Paratype female n° 2 with long inner coxal seta on left swimming leg 2 (fig. 3C).

TABLE V

Variations in formulae of the armature of swimming legs 1-4 of the paratype ♂ of *Gerulososacculus commutabilis* n. gen., n. sp. with regard to those of the holotype. Parentheses relate to the armature state of a right leg segment when asymmetry occurs

	Exopod	Endopod
Leg 4	I-1; I-1; II(III), I, 4	0-1; 0-2; 1, 1, 2

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