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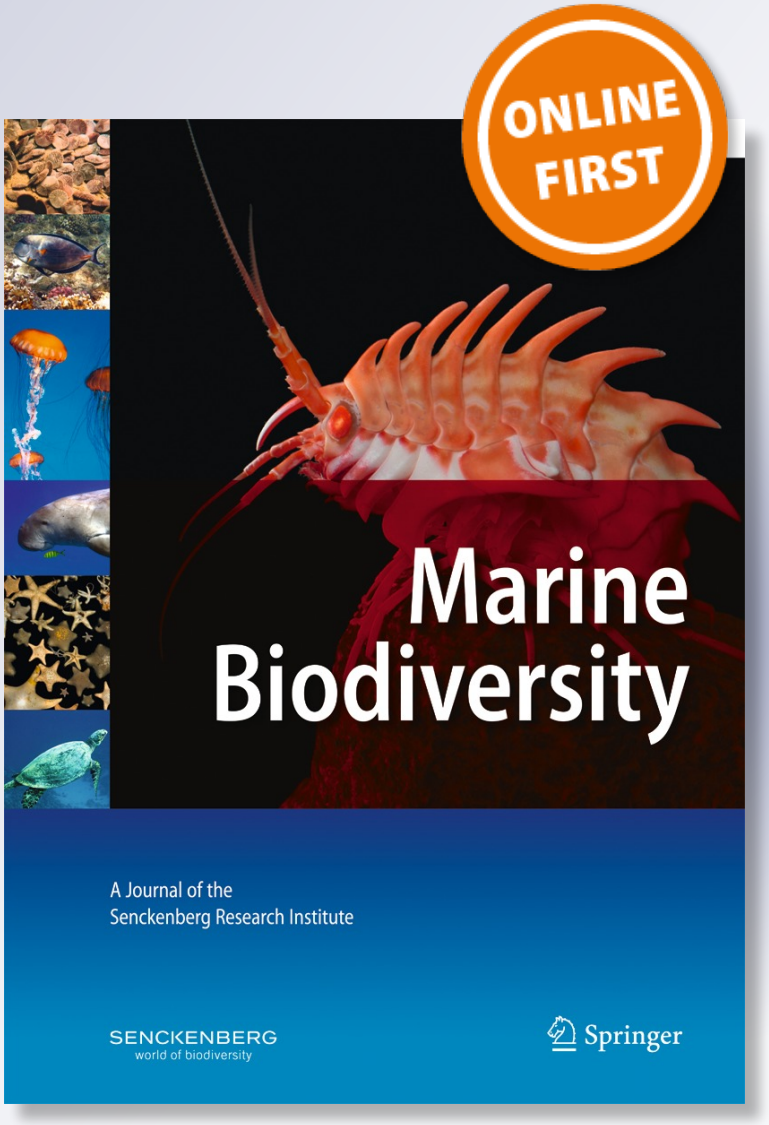

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ORIGINAL PAPER

Two new cumaceans (Crustacea: Peracarida) from the South-West Atlantic with remarks on the problematic genus *Holostylis* Stebbing, 1912

Daniel Roccatagliata[1,2] · **Natalia A. Alberico**[1,2]

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Abstract In 1912-13, Stebbing erected the genera *Holostylis* and *Ekdiastylis* for those diastylids with the endopod of the uropods being one- and two-segmented, respectively. The validity of the genus *Holostylis* is still controversial and the genus *Ekdiastylis* continues to be suppressed. In the present contribution, two new diastylids are fully described and illustrated: one of them has the endopod of the uropod one-segmented, *Holostylis uniramosa* n. sp., and the other has the endopod of the uropod two-segmented, *Diastylis decalineata* n. sp. The genus *Holostylis* has currently three nominal species, which are easily distinguished from each other by the number of thoracic appendages with fully developed exopods in females: three in *H. helleri* (Zimmer, 1908), one in *H. spinicuadata* Błażewicz-Paszkowycz and Heard, 2005, and none in *H. uniramosa* n. sp. The validity of genus *Holostylis* is confirmed and its diagnosis emended. *Diastylis decalineata* n. sp. mainly distinguished from the other species of *Diastylis* with two-segmented uropod endopods by the shape and sculpture of its carapace.

Keywords *Holostylis* · *Diastylis* · New species · Cumacea · Argentina

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Introduction

Stebbing (1912, 1913) erected the genera *Holostylis* and *Ekdiastylis* to accommodate those species of *Diastylis* with the endopod of the uropods being one- and two-segmented, respectively.

The genus *Ekdiastylis* continues to be suppressed. In contrast, the genus *Holostylis* was accepted by some authors (Hale 1937; Ledoyer 1969; Arnaud 1974; Day 1980; Błażewicz-Paszkowycz and Heard 2005) but not by others (Calman 1917, 1918; Zimmer 1941; Lomakina 1968; Jones 1969; Băcescu 1992; Błażewicz-Paszkowycz and Jażdżewski 1995; Mühlenhardt-Siegel 1999; Corbera 2000; Petrescu and Wittmann 2003; Rehm et al. 2007). Furthermore, Ledoyer (1993) suggested keeping *Holostylis* and *Ekdiastylis* as two subgenera of *Diastylis*.

In the present contribution, two new species from the South-West Atlantic are fully described and illustrated: one of them has the endopod of the uropod one-segmented, *Holostylis uniramosa* n. sp., and the other has the endopod of the uropod two-segmented, *Diastylis decalineata* n. sp. In addition, the validity of the genus *Holostylis* is confirmed and its diagnosis emended.

The genus *Holostylis* currently contains three nominal species: *Holostylis helleri* (Zimmer, 1907); *Holostylis spinicauda* Błażewicz-Paszkowycz and Heard, 2005 and a new species herein described, *Holostylis uniramosa* n. sp. The female of *H. helleri* has fully developed exopods on the third maxilliped and the first two pereopods (plesiomorphic character), the female of *H. spinicauda* has fully developed exopods on the third maxilliped only, whereas that of *H. uniramosa* n. sp. has no thoracic exopods at all. According to the criterion traditionally used in the taxonomy of Cumacea, the differences mentioned above in the number of exopods would suffice to place these three species in separated genera. However, we believe

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that these three species are congeneric, and that the loss of female exopods is the primary factor of speciation within the genus *Holostylis*.

Material and methods

The samples examined in this study were collected off the coast of Buenos Aires and Río Negro Provinces, and in the Burdwood Bank, between 51 and 284 m depth. The illustrated specimens were stained with Chlorazole Black E. Their appendages were dissected and mounted in glycerin on temporary slides. Illustrations were made with the aid of drawing tubes attached to a Leica MZ8 dissecting microscope and a Carl Zeiss Axioskop compound microscope. All dissected appendages were finally stored together with other body remains in 70 % ethanol. The specimens used to draw the habitus were not dissected and the illustrations of the appendages were based on additional paratypes.

Body lengths were measured from the tip of the pseudorostrum to the end of the telson (distal setae excluded). The carapace length has been taken from the tip of pseudorostrum to posterior margin of carapace. In the descriptions of the appendages the term "remaining articles together" stands for the ischium to dactylus length, not including terminal setae. The length of single articles was taken along their longer sides. In the case that two or more articles are jointly measured, the length of these articles has been taken along their middle lines. The telsonic pre-anal and post-anal parts were measured with the specimen in ventral view: the former extends to the tip of the anal valves; the latter does not include the distal cuspidate setae.

For the definitions of the different types of setae, we follow the terminology presented by Garm (2004) (*see* also Alberico and Roccatagliata 2008, 2011 and 2013).

For the scanning electron microscope (SEM) photographs, the specimens were rinsed in 0.5 % nonionic detergent Triton X100 and the detritus removed with the help of an ultrasonic cleaner and/or a fine brush. The specimens were then dehydrated through a graded series of ethanol and critical point dried. After sputter coating the specimens with colloidal gold, they were examined with a Philips XL30 TMP scanning electron microscope.

Type and reference specimens were deposited in the invertebrate collection of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN). All these specimens are preserved in 70 % ethanol, except for those prepared for SEM examination, which are dry and stuck on aluminum stubs.

Order Cumacea Kröyer, 1846
Family Diastylidae Bate, 1856
Genus *Holostylis* Stebbing, 1912

Diagnosis (emended). Integument strongly calcified. Carapace and pereon ornamented with conical tubercles. Mandible navicular. Adult females with fully developed exopods on the maxilliped 3 and pereopods 1–2, on the maxilliped 3 only, or lacking exopods. Adult male with fully developed exopods on maxilliped 3 and pereopods 1–4. Telson slightly longer than uropod peduncle, with lateral cuspidate setae. Uropod endopod of one article. Males with two pairs of pleopods.

Species included in this genus: *Diastylis helleri* Zimmer, 1907 (type species), *Holostylis spinicauda* Błażewicz-Paszkowycz and Heard, 2005, and *Holostylis uniramosa* n. sp.

Remarks on the genus *Holostylis*

Stebbing (1912, 1913) erected the genus *Holostylis* (and the family Holostylidae) to receive *Diastylis helleri* Zimmer, 1907 and a poorly known form, *Cuma gayi* Nicolet, 1849 (now a species *incertae sedis*). Most recently, Błażewicz-Paszkowycz and Heard (2005) described *Holostylis spinicauda*. Finally, in the present contribution the third species of the genus is described: *H. uniramosa* n. sp. These three species not only have uniarticulate uropodal endopods but also large conical tubercles on the carapace and thorax. In addition, all of them were found in deep and/or cold waters in the Southern Hemisphere (Antarctic, South Georgia and Magellan region). Thus, we believe that *H. spinicauda* and *H. uniramosa* n. sp. are congeneric with *H. helleri*, and that the genus *Holostylis* is actually a valid taxon.

For the three species included up to now in this genus the adult male is still unknown. However, descriptions of the immature male of *H. helleri* were presented by Zimmer (1909), Lomakina (1968), Petrescu and Wittmann (2003) and Błażewicz-Paszkowycz and Heard (2005). Regarding *H. spinicauda,* Błażewicz-Paszkowycz and Heard (op. cit.) listed one juvenile male among the material examined but they did not describe it. Lastly, for *H. uniramosa* n. sp. 3 mancae and 17 juvenile males are herein reported (*see* below).

Petrescu and Wittmann (2003) redescribed *Diastylis helleri* based on material from Weddell Sea and they noticed that the uropod endopod consists of three articles separated by poorly visible articulations. In contrast, we have examined 21 additional specimens of *H. helleri* from its type locality (South Georgia) and all of them have uniarticulate uropodal endopods.

Błażewicz-Paszkowycz and Heard (2005) reported the presence of exopods on the female third maxilliped in the emended diagnosis of the genus, and in the descriptions of *H. helleri* and *H. spinicauda*. However, even though this is a key taxonomic character, the authors did not draw the exopods of the third maxilliped in figures 2H (*H. helleri)* and 7D

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(*H. spinicauda*), rendering these descriptions somewhat incomplete.

***Holostylis uniramosa* n. sp.**

(Figures 1–4)

Material examined. TALUD CONTINENTAL 2012, R/V Puerto Deseado. Mar del Plata Submarine Canyon, Sta. 3 (6), 37° 58.337′S, 55°8.915′W, 530 m, 10 Aug 2012: 2 juvs., 3 mancae (MACN-In. 39816). –**COPLA II, R/V Puerto Deseado**. Sta. 3, 38°41.05′S, 55°56.93′W, 208 m, 05 Jun 2010: 1 ad. ♀ (holotype, MACN-In. 39817), 1 ad. ♀, 7 juvs. (paratypes, MACN-In. 39818). Sta. 4, 39°58.53′S, 56°11.12′W, 127 m, 05 Jun 2010: 1 ad. ♀, 1 juv., 2 mancae (MACN-In. 39819). Sta. 11, 42°19.99′S, 58°24.97′W, 284 m, 06 Jun 2010: 1 manca (MACN-In. 39820). –**CAV 2013, R/V Puerto Deseado**. Burdwood Bank, Sta. 6, 54°15.81′S, 59°59.04′W, 21 Mar 2013, 103 m: 1 subad. ♀, 22 juvs., 2 mancae (MACN-In. 39821).

Description of the adult female (based on holotype MACN-In. 39817 and paratype MACN-In. 39818a)

Total length (holotype): 12.6 mm.

Carapace (Fig. 1a, b) 1.3 times as long as wide. Surface whitish and calcified, covered with small and large conical tubercles (the latter with translucent rounded ends, Fig. 4b). Large conical tubercles (ten in all) are symmetrically distributed at each side of carapace: three arranged on an imaginary line running obliquely from antero-lateral margin to postero-dorsal surface of carapace, one close to each frontal lobe fissure, and one behind frontal lobe at each side of mid-dorsal line. Conical tubercles on the diagonal are mostly the largest. Although this pattern is not so evident in specimens showing numerous tubercles, the large tubercles "1" and "3" on the diagonal line are always recognized (Figs. 1e and 4a, c). Ocular lobe slightly longer than wide, without lenses. Pseudorostrum slightly more than 3 times ocular lobe length. Lower margin strongly serrated. Antero-lateral angle absent, antennal notch shallow.

Pereon (Fig. 1a, b) 0.8 as long as carapace. Each pereonite with at least a pair of mid-dorsal large conical tubercles (absent on the first pereonite of holotype) and many small ones, mid-dorsal tubercles on the fourth pereonite the largest.

Pleon (Fig. 1a) slightly shorter than cephalothorax.

First antenna (Fig. 1c). Peduncle, first article 1.2 times as long as second and third combined, inner distal corner with 1 setulate seta, outer distal corner with 1 simple seta arched over article, distal margin with 1 large tooth; second article approximately as long as third, both articles with broom and small simple setae. Main flagellum of three articles; first article approximately as long as second, second article with 1 aesthetasc distally; third article with 1 aesthetasc basally and simple and broom setae distally. Accessory flagellum of three articles, reaching approximately two-thirds of the way along the first article of main flagellum.

Second antenna (Fig. 1d). Of 4 articles, distal one minute. First article with 2 setae (1 setulate, 1 broken), second to fourth articles with 1 setulate seta each.

Mandibles. As that of *Holostylis spinicauda* Błażewicz-Paszkowycz and Heard, 2005. Left mandible, *pars incisiva* with a well developed *lacinia mobilis* and 15 setae. Right mandible as left except for *lacinia mobilis* rudimentary.

First maxilla. As that of *Holostylis spinicauda* Błażewicz-Paszkowycz and Heard, 2005, i.e., outer endite with 1 short setulate seta on outer margin and 14 setae distally; inner endite with 5 unequal setae distally.

Second maxilla. As that of *Holostylis spinicauda* Błażewicz-Paszkowycz and Heard, 2005, i.e., outer endite with 6 setae; inner endite with 4 setae.

First maxilliped (Fig. 2a). Basis with 7 setuloserrate setae on inner margin. Carpus, with a row of 6–7 setuloserrate setae (becoming gradually longer toward distal end) on inner margin, 1 large setulate seta on outer distal corner, and barely setulate setae with rounded tip - many on ventral surface and a few on inner distal angle (not drawn). Propodus with 2 unequal serrate setae on inner distal corner, 2 large setulate setae distally, and many barely setulate setae with rounded tip on ventral surface and inner margin (not drawn). Dactylus with 2 finely serrate (serrulate?) setae distally.

Second maxilliped (Fig. 2b). Basis 1.1 times as long as remaining articles together with 5 setulate and simple setae on outer margin and 5–6 setulate setae distally. Ischium small and wedge-shaped (visible only on ventral view). Merus 0.8 as long as carpus and 1.2 times as long as propodus, with 1 setulate seta on outer distal corner and 2 setulate setae on or near inner margin. Carpus with 2 unequal setulate setae on outer distal corner and 8 setulate/setulo-serrulate setae on inner margin. Propodus, outer margin with 1 large setulate seta at approximately one-third of the way along the article and 1 barely setulate seta distally; inner margin with 5–7 barely setulate setae and 3 setulo-serrulate setae in between (only a few setae drawn). Dactylus with several serrulate and simple setae distally.

Third maxilliped (Fig. 2c). Basis approximately twice as long as remaining articles together, inner margin with setulate setae, dorsal surface with a row of teeth proximally and 1 large tooth distally; outer distal lobe not reaching the ischium-merus articulation, with 5 setulate setae. Ischium with 4 setulate setae on inner margin and 1 large tooth distally. Merus approximately as long as carpus, with 3 setulate setae on inner margin, and 1 strong setulate seta and 2 teeth on outer margin. Carpus 0.9 as long as propodus, with 6 setulate setae on inner margin/dorsal surface, and 1 short setulate seta on outer distal corner. Propodus with 4 setulate setae on inner margin and 1 setulate

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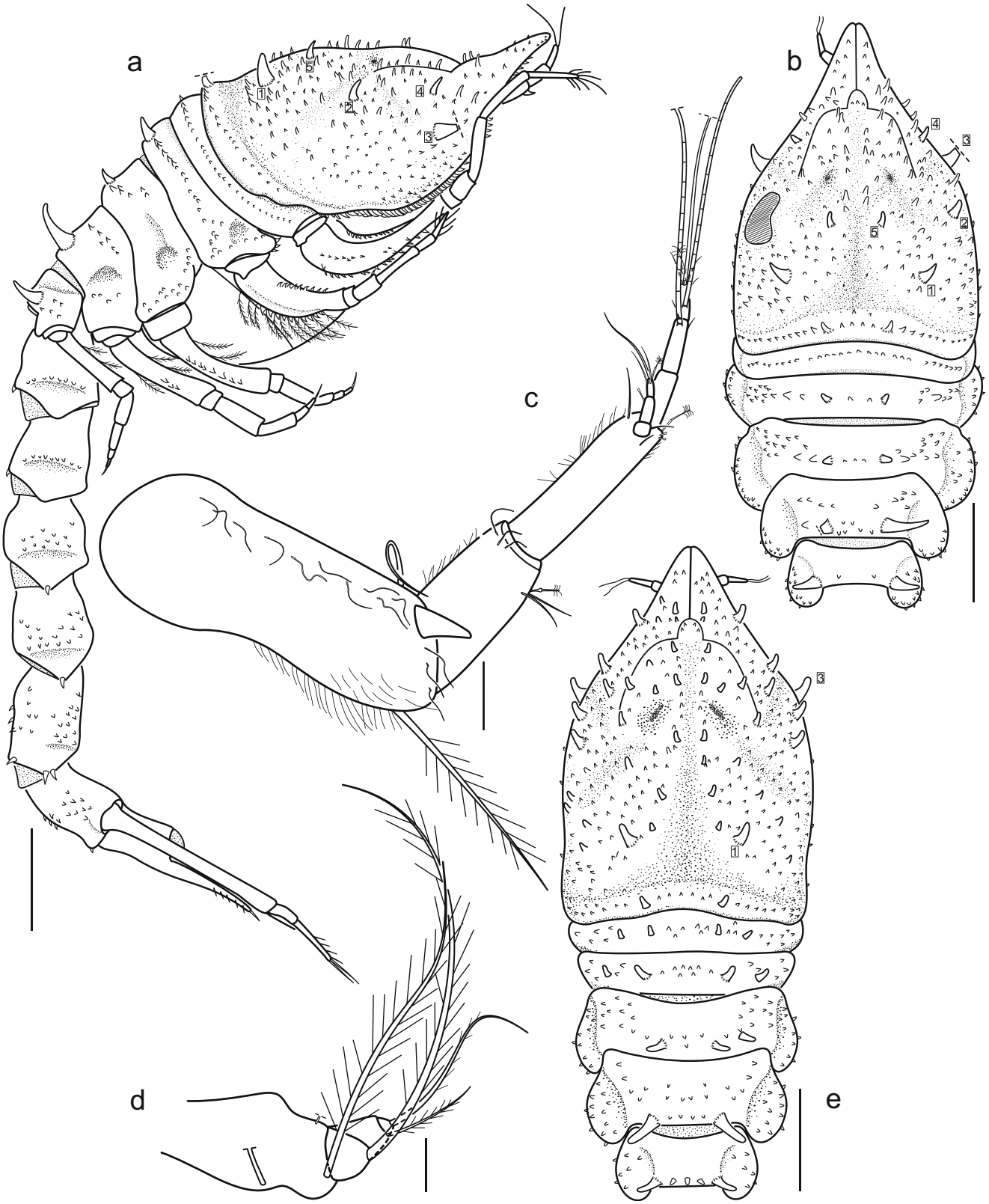

Fig. 1 *Holostylis uniramosa* n. sp., adult female (**a**, **b** holotype MACN-In. 39817; **c**, **d** paratype MACN-In. 39818): **a** Habitus in lateral view; **b** cephalothorax in dorsal view; **c** first antenna; **d** second antenna. Subadult female (MACN-In. 39821a): **e** Cephalothorax in dorsal view. Numbers stand for: *1-3* large conical tubercles on a diagonal line; *4* large conical tubercles close to frontal lobe fissure; *5* large conical tubercles at each side of mid-dorsal line. *Scale bars*: 1 mm (**a**–**b**, **e**), 0.1 mm (**c**, **d**)

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Fig. 2 *Holostylis uniramosa* n. sp., adult female (paratype MACN-In. 39818). **a** First maxilliped; **b** second maxilliped; **c** third maxilliped. *Scale bars*: 0.2 mm (**a**–**c**)

seta on outer distal corner. Dactylus 0.75 as long as propodus, with several simple and serrulate setae. Without exopod.

First pereopod (Fig. 3a). Basis 0.7 as long as remaining articles together, with setulate setae on both margins and

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Fig. 3 *Holostylis uniramosa* n. sp., adult female (paratype MACN-In. 39818). **a** First pereopod; **b** second pereopod; **c** third pereopod; **d** fifth pereopod; **e** last pleonite, telson and uropod. *Scale bars*: 0.5 mm (**a**–**e**)

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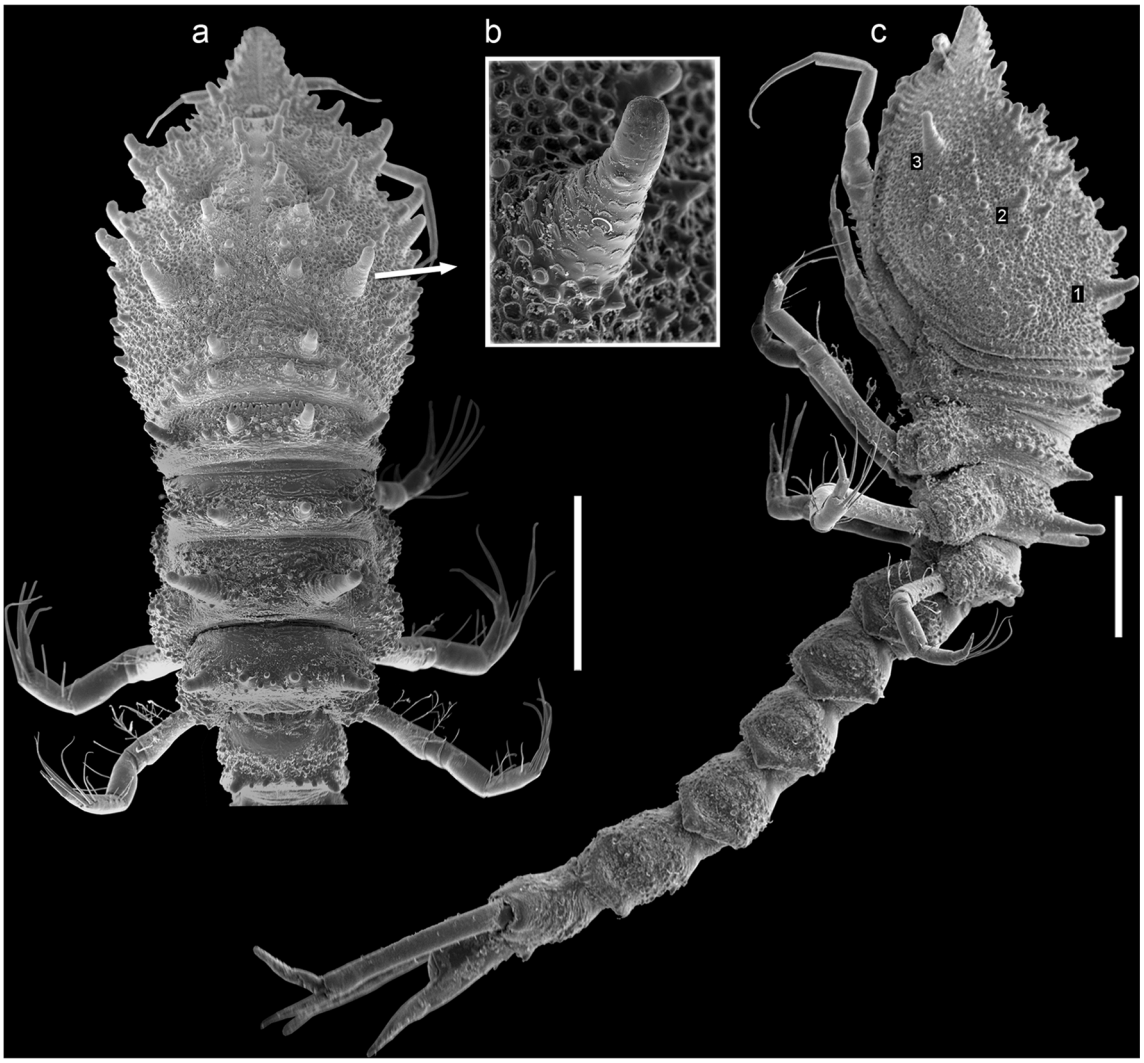

Fig. 4 SEM photographs. *Holostylis uniramosa* n. sp., juvenile (MACN-In. 39821b). **a** Cephalothorax in dorsal view; **b** detail of large tubercle of the carapace; **c** habitus in lateral view . Numbers *1-3* stand for the large conical tubercles on a diagonal line. *Scale bars*: 1 mm (**a**, **c**)

distally, and teeth scattered on dorsal surface (distal tooth the largest). Ischium to dactylus with simple setae only. Carpus 1.3 times as long as ischium and merus combined. Dactylus 0.9 as long as propodus. Exopod absent.

Second pereopod (Fig. 3b). Basis 0.8 as long as remaining articles together, with setulate setae on inner margin and distally and teeth on dorsal surface. Merus with 1 setulate seta on inner margin and 1 tooth on outer distal corner. Carpus to dactylus with simple setae only. Carpus 1.3 times as long as ischium and merus combined. Dactylus 1.8 times as long as propodus. Exopod absent.

Third pereopod (Fig. 3c). Basis 1.1 times as long as remaining articles together, with setulate and simple setae. Ischium with setulate setae (ischium of the opposite pereopod with simple and setulate setae). Merus with simple setae. Carpus 0.8 as long as merus, with 8–9 simple/barely setulate setae. Propodus with 1 simple seta distally. Dactylus with 1 short simple seta at approximately half-way along article and 2 simple setae (1 minute, 1 large) distally. Exopod absent.

Fourth pereopod as third except for: basis 0.9 as long as remaining articles together, with fewer setae.

Fifth pereopod (Fig. 3d). Basis 0.7 as long as remaining articles together, with a few setulate and simple setae. Ischium with setulate setae (ischium of the opposite pereopod with simple and setulate setae). Merus with simple setae. Carpus approximately as long as merus, with 10–12 simple/setulate setae. Propodus with 1 simple seta distally. Dactylus with 2 short simple setae at approximately half-way along article and 2 simple setae (1 minute, 1 large) distally. Exopod absent.

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Telson (Fig. 3e) twice as long as last pleonite (excluding distal cuspidate setae), pre-anal part 1.2 times as long as post-anal part, each side with 6 cuspidate setae with sensory tip, distal end with 2 large cuspidate setae.

Uropod (Fig. 3e). Peduncle 1.1 times as long as telson (excluding distal cuspidate setae), with 12 cuspidate setae with sensory tip on inner margin. Endopod of 1 article, with 7 cuspidate setae with sensory tip on inner margin and 1 distally. Exopod 1.4 times as long as endopod, with two rows of short simple setae along article and 2 long simple setae distally.

Etymology. The species epithet refers to the lack of exopods in the female third maxilliped and pereopods.

Distribution. Burdwood Bank and off the coast of Buenos Aires and Río Negro Provinces, between 103 and 530 m depth.

Remarks

The sculpture of the carapace of *Holostylis uniramosa* n. sp. is highly variable. In specimens having heavy ornamented carapaces, some of the large conical tubercles are frequently not recognized. However, the tubercles "1" and "3" are always distinct (*see* Figs. 1e and 4c). The three large tubercles arranged on a diagonal line are also noticeable in the adult females of *H. helleri* (*see* Zimmer 1909, figure 84) and *H. spinicauda* (*see* Błażewicz-Paszkowycz and Heard 2005, figure 5, bottom drawing). Moreover, these three tubercles were observed in digital images of the holotype of *H. spinicauda* sent to us.

The armature of the carapace of *H. helleri* is also highly variable: specimens with spinous tubercles, nodular excrescences, and intermediate forms have been reported (*see* Calman, 1918 figure 4; Błażewicz-Paszkowycz and Heard 2005, figure 4). We have examined 1 adult female plus 19 immature specimens of *H. helleri* from South Georgia (MACN-In 39871). The ornamentation of the carapace of these specimens agrees with that of the type material of *H. helleri* (*see* Zimmer 1909, figure 84; Calman 1818, figure 4A).

The sculpture of carapace seems not to be a useful character to separate these three species. Besides, the large tubercles are usually broken, making the use of this character difficult. Despite that, these species can easily be distinguished from each other by the number of exopods carried by the females. The juvenile, subadult and adult females of *H. helleri* have fully developed exopods on the maxilliped 3 and pereopods 1 and 2 (Zimmer 1909; Petrescu and Wittmann 2003; Błażewicz-Paszkowycz and Heard 2005, and the specimens herein reported). The adult females of *H. spinicauda* have fully developed exopods only on the maxilliped 3 (the subadult females also have vestigial exopods on pereopods 1 and 2) (Błażewicz-Paszkowycz and Heard 2005). Finally, the juvenile, subadult and adult females of *H. uniramosa* n. sp. lack exopods both on the third maxilliped and the pereopods.

Fig. 5 *Diastylis decalineata* n. sp., adult female (**a**, **b** holotype MACN-In. 39823; **c**, **d** paratype MACN-In. 39824a). **a** Habitus in lateral view; **b** cephalothorax in dorsal view. **c** first antenna; **d** second antenna. Numbers stand for the rows of blunt tubercles: *1*, *2*, and *3* inferior, middle and upper rows, respectively; *4* and *5* anterior and posterior mid-dorsal rows, respectively. *Scale bars*: 1 mm (**a**, **b**), 0.1 mm (**c**, **d**) ▶

The adult male of *H. uniramosa* n. sp. is unknown. However, 17 juveniles and 3 mancae with developing exopods on maxilliped 3 and pereopods 1–4 were found among the material studied herein. Thus, we can assume that the adult male of *H. uniramosa* n. sp. has fully developed exopods in these five appendages. Furthermore, the third maxilliped and the pereopods lack exopods in all the females examined (3 adults, 2 subadults and 15 juveniles), and there is no indication that they have been broken off during collection and handling.

The three *Holostylis* species up to now reported for this genus differ also in their range of geographic and bathymetric distributions. *Holostylis helleri* was recorded from South Georgia (Zimmer 1907, 1909), and after that found in many Subantarctic and Antarctic localities, between 12 and 640 m depth (Calman 1917, 1918; Hale 1937; Lomakina 1968; Ledoyer 1993; Błażewicz-Paszkowycz and Jażdżewski 1995; Mühlenhardt-Siegel 1999; Petrescu and Wittmann 2003; Błażewicz-Paszkowycz and Heard 2005). *Holostylis spinicauda* was recorded only from its type locality, South Georgia at 3,056–3,102 m depth (Błażewicz-Paszkowycz and Heard 2005). Lastly, *H. uniramosa* n. sp. was collected in the Burdwood Bank and off Buenos Aires and Río Negro Provinces at 103–530 m depth.

Genus *Diastylis* Say, 1818

***Diastylis decalineata* n. sp.**

(Figures 5–10)

Material examined. CAMPAIGN MEJILLÓN II, R/V Puerto Deseado. Sta. 4, 38°14.928′S, 57°01.686′W, 55–60 m, 10 Sep 2009: 1 ad. ♀ (MACN-In. 39822). Sta. 11, 39°00.431′S, 58°10.285′W, 61 m, 12 Sep 2009: 1 ad. ♀ (holotype, MACN-In. 39823), 5 ad. ♀♀, 9 subad. ♀♀, 3 ad. ♂♂, 1 subad. ♂, 9 juvs., 49 mancae (paratypes, MACN-In. 39824). Sta. 18, 37°42.644′S, 56°33.409′W, 51.4 m, 14 Sep 2009: 1 ad. ♀, 4 subad. ♀♀, 3 juvs., 9 mancae (MACN-In. 39825). – **QUEQUÉN**. 15 Dec 2005. Sta. 9, 38°47.216′S, 58°41.604′W, 51.7 m: 1 subad. ♂ (MACN-In. 29826). Sta. 12, 38°50.557′S, 58°41.079′W, 57.7 m: 1 ad. ♀ (MACN-In. 39827). Sta. 13, 38°50.659′S, 58°40.954′W, 60 m: 1 manca (MACN-In. 39828).

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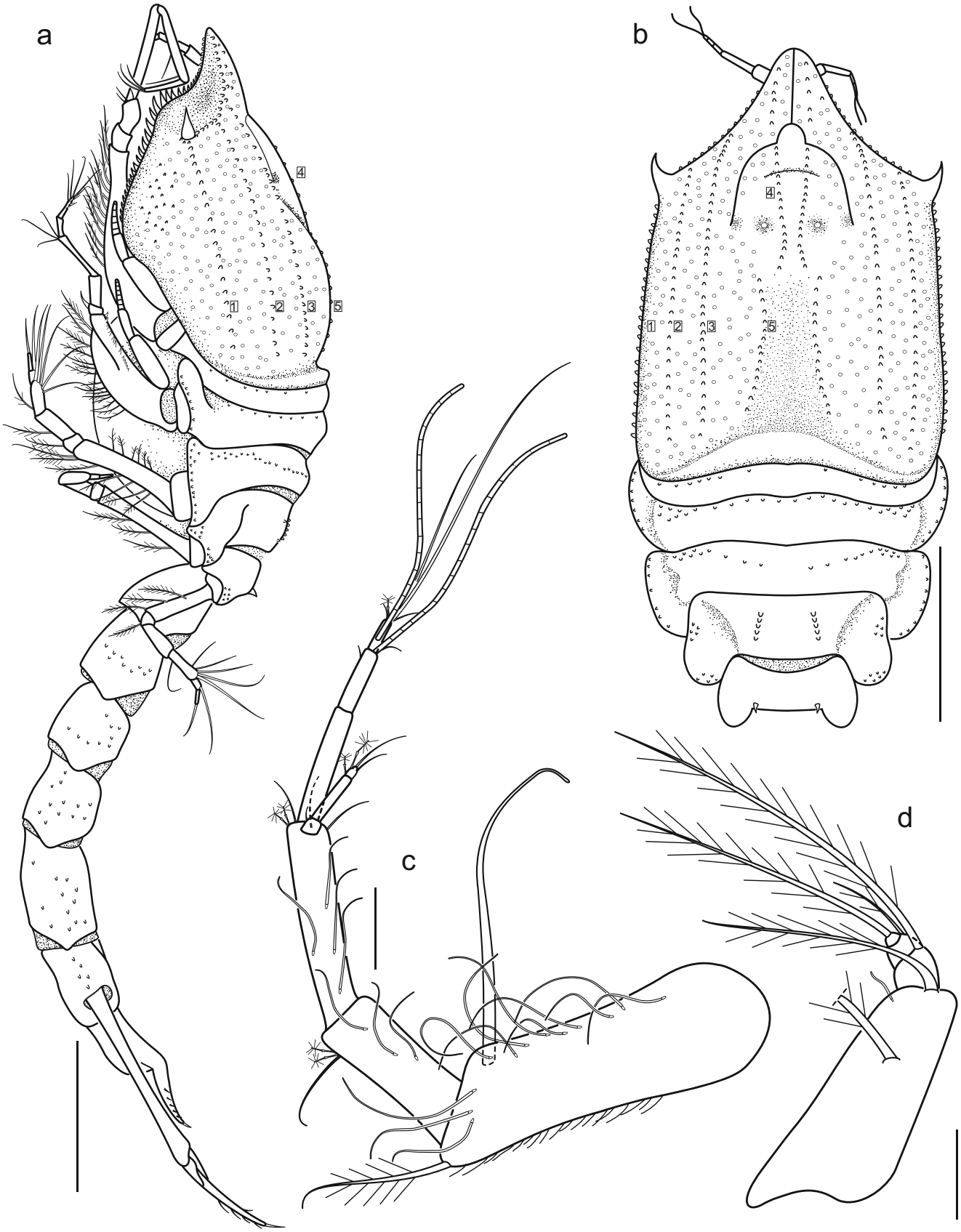

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Fig. 6 *Diastylis decalineata* n. sp., adult female (paratype MACN-In. 39824a). **a** First maxilliped; **b** second maxilliped; **c** third maxilliped. *Scale bars*: 0.2 mm (**a**–**c**)

Diagnosis. Integument whitish and heavily calcified. Carapace, surface pitted; sides with a large antero-lateral horn, one arched and three horizontal rows of blunt tubercles (infero-horizontal row more developed in males), mid-dorsal surface with two anterior and two posterior horizontal rows of blunt tubercles. Pereopods 3 and 4 of female lacking exopods. Endopod of uropods of 2 articles. Telson with 5–6 (adult female) and 8–10 (adult male) cuspidate setae on each side.

Description of the adult female (based on holotype MACN-In. 39823 and paratype MACN-In. 39824a)

Total length (holotype): 7.2 mm.

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Fig. 7 *Diastylis decalineata* n. sp., adult female (paratype MACN-In. 39824a). **a** First pereopod; **b** second pereopod; **c** third pereopod; **d** fifth pereopod; **e** last pleonite, telson and uropod. *Scale bars*: 0.5 mm (**a**–**e**)

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Fig. 8 *Diastylis decalineata* n. sp., adult male (**a**, **b** paratype MACN-In. 39824b; **c**, **d** paratype MACN-In. 39824c). **a** Habitus in lateral view; **b** cephalothorax in dorsal view. **c** first antenna; **d** left mandible. Numbers stand for rows of blunt tubercles: *1*, *2*, and *3* inferior, middle and upper lateral rows, respectively; *4* and *5* anterior and posterior mid-dorsal rows, respectively. *Scale bars*: 1 mm (**a**, **b**), 0.1 mm (**c**, **d**)

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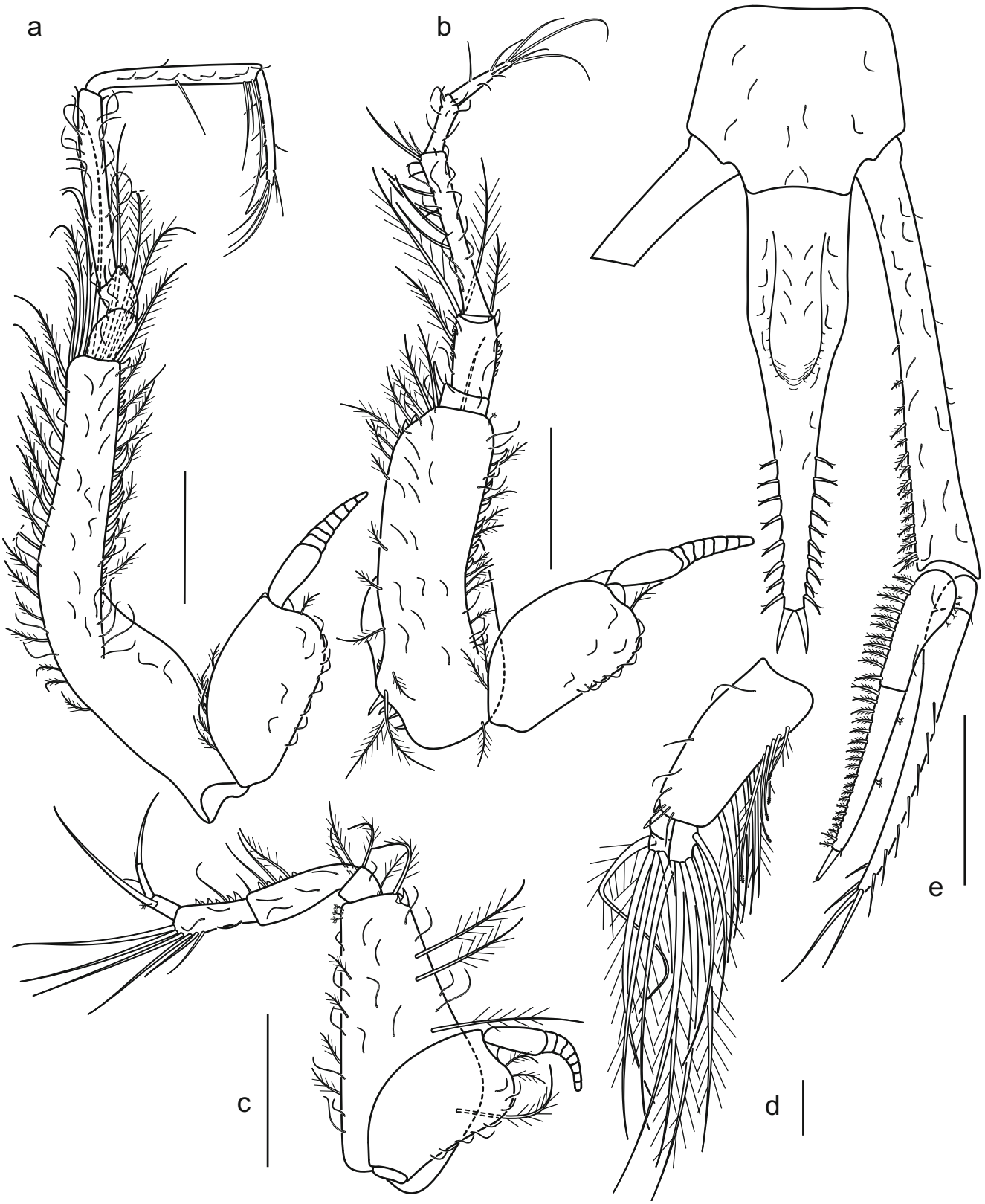

Fig. 9 *Diastylis decalineata* n. sp., adult male (paratype MACN-In. 39824c). **a** First pereopod; **b** second pereopod; **c**, third pereopod; **d** first pleopod; **e** last pleonite, telson and uropod. *Scale bars*: 0.5 mm (**a**–**c**, **e**), 0.1 mm (**d**)

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Carapace (Figs. 5a, b and 10a–c) 1.4 times as long as wide. Surface whitish and covered all over with small pits. Sides of carapace with a large antero-lateral horn (cornu), an arched row of blunt tubercles that extends from the tip of pseudorostrum to the horn, and three horizontal rows of blunt tubercles, namely: inferior row running back from antero-lateral horn, and middle and upper rows running back from arched row. These three lateral rows end a short distance before reaching posterior margin of carapace. Mid-dorsal surface with four horizontal rows of blunt tubercles, mainly: two contiguous rows starting at the tip of pseudorostrum, continuing on frontal lobe and ending at middle of carapace, two posterior rows starting slightly behind and outside anterior contiguous rows, and almost reaching posterior margin of carapace. Ocular lobe slightly wider than long, without lenses. Pseudorostrum approximately 4 times as long as ocular lobe. Lower margin strongly serrate. Antero-lateral angle rounded, antennal notch shallow.

Pereon (Figs. 5a, b and 10a, b) 0.6 as long as carapace.

Pleon (Fig. 5a) 0.7 as long as cephalothorax.

First antenna, third maxilliped, pereopods, pleopods and uropods with many sinuate setae. These setae look like fungal hyphae, i.e., they are translucent and have uniform thickness. The presence of these setae is not mentioned in the descriptions down below. Furthermore, for the sake of clarity only a few of them are shown in the figures.

First antenna (Fig. 5c). Peduncle, first article approximately as long as second and third combined, inner distal corner with 1 setulate seta, outer margin with 1 long simple seta; second article 0.8 as long as third, both articles with small simple setae and broom setae. Main flagellum of three articles, first article approximately twice as long as second, second article with 1 aesthetasc distally, third article with 1 aesthetasc basally, and simple and broom setae distally. Accessory flagellum reaching approximately two-thirds of the way along the first article of main flagellum; of three articles, second one the longest.

Second antenna (Fig. 5d). With 4 articles, distal one minute. First article with 2 setulate setae and 1short sinuate seta, second to fourth articles with 1 setulate seta each.

Left mandible. *Pars incisiva* with a well developed *lacinia mobilis* and 11 setae. Right mandible as left except for *lacinia mobilis* rudimentary

First maxilla. As that of *Diastylis fabrizioi* Alberico and Roccatagliata 2008, i.e., outer endite with 14 setae distally and 1 short setulate seta on outer margin; inner endite with 5 unequal setae distally.

Second maxilla. As that of *Diastylis fabrizioi* Alberico and Roccatagliata 2008, i.e., outer endite with 6 setae; inner endite with 4 setae.

Fig. 10 SEM photographs. *Diastylis decalineata* n. sp., adult female (paratype MACN-In. 39824d). **a** Cephalothorax in lateral view; **b** cephalothorax in dorsal view; **c** detail from the area marked with the *white rectangle* in **b**. Adult male (paratype MACN-In. 39824e). **d** Cephalothorax in dorso-lateral view; e habitus in dorsal view. Numbers stand for rows of blunt tubercles: *1*, *2*, and *3* inferior, middle and upper lateral rows, respectively; *4* and *5* anterior and posterior mid-dorsal rows, respectively. *Scale bars*: 1 mm (**a**, **b**, **d**, **e**)

First maxilliped (Fig. 6a). Basis with 5–6 setuloserrate setae on inner margin. Carpus, with a row of 6–7 setuloserrate setae (becoming gradually longer toward distal end) on inner margin, 1 large setulate seta on outer distal corner, and many barely setulate setae with rounded tip on ventral surface and a few on inner distal angle (not drawn). Propodus with 2 unequal serrate setae on inner distal corner, 2 large setulate setae distally, and many simple/barely setulate setae with rounded tip on ventral surface and inner margin (not drawn). Dactylus with 2 finely serrate (serrulate?) setae distally.

Second maxilliped (Fig. 6b). Basis 0.9 as long as remaining articles together, distal margin with 4 setulate setae on one side and 2 short simple and 1 setulate setae on opposite side. Ischium wedge shaped (visible only on ventral view). Merus 0.6 as long as carpus and approximately as long as propodus, with 1 setulate seta on outer distal corner and 2 setulate setae on inner margin. Carpus with 2 unequal setulate setae on outer distal corner and 8–9 barely setulate/setulo-serrulate setae on inner margin (only 4 setae drawn). Propodus, outer margin with 1 large setulate seta at approximately one-third of the way along the article and 1 barely setulate seta distally; inner margin with 8–10 barely setulate setae and 4 setulo-serrulate setae in between (only a few setae drawn). Dactylus with serrulate and simple setae distally.

Third maxilliped (Fig. 6c). Basis 1.5 times as long as remaining articles together, inner margin with setulate setae and teeth (distal tooth the largest); outer distal lobe not reaching the ischium-merus articulation, with 4 long and 1 short setulate setae. Ischium with 2–3 setulate setae on inner margin. Merus 0.65 as long as carpus, with 2 setulate setae on inner margin and 1 strong setulate seta on outer distal corner. Carpus 0.9 as long as propodus, with 4 setulate setae on or near inner margin and 2 unequal setulate setae on outer distal corner. Propodus with 7–8 barely setulate setae (only 3 drawn) on inner margin and 1 simple seta on outer distal corner. Dactylus 0.7 as long as propodus, with several simple and serrulate setae. Exopod flagellum of six articles (setae not drawn).

First pereopod (Fig. 7a). Basis 0.8 as long as remaining articles together, with setulate setae on both margins and distally, and with teeth on outer margin. Ischium to dactylus with

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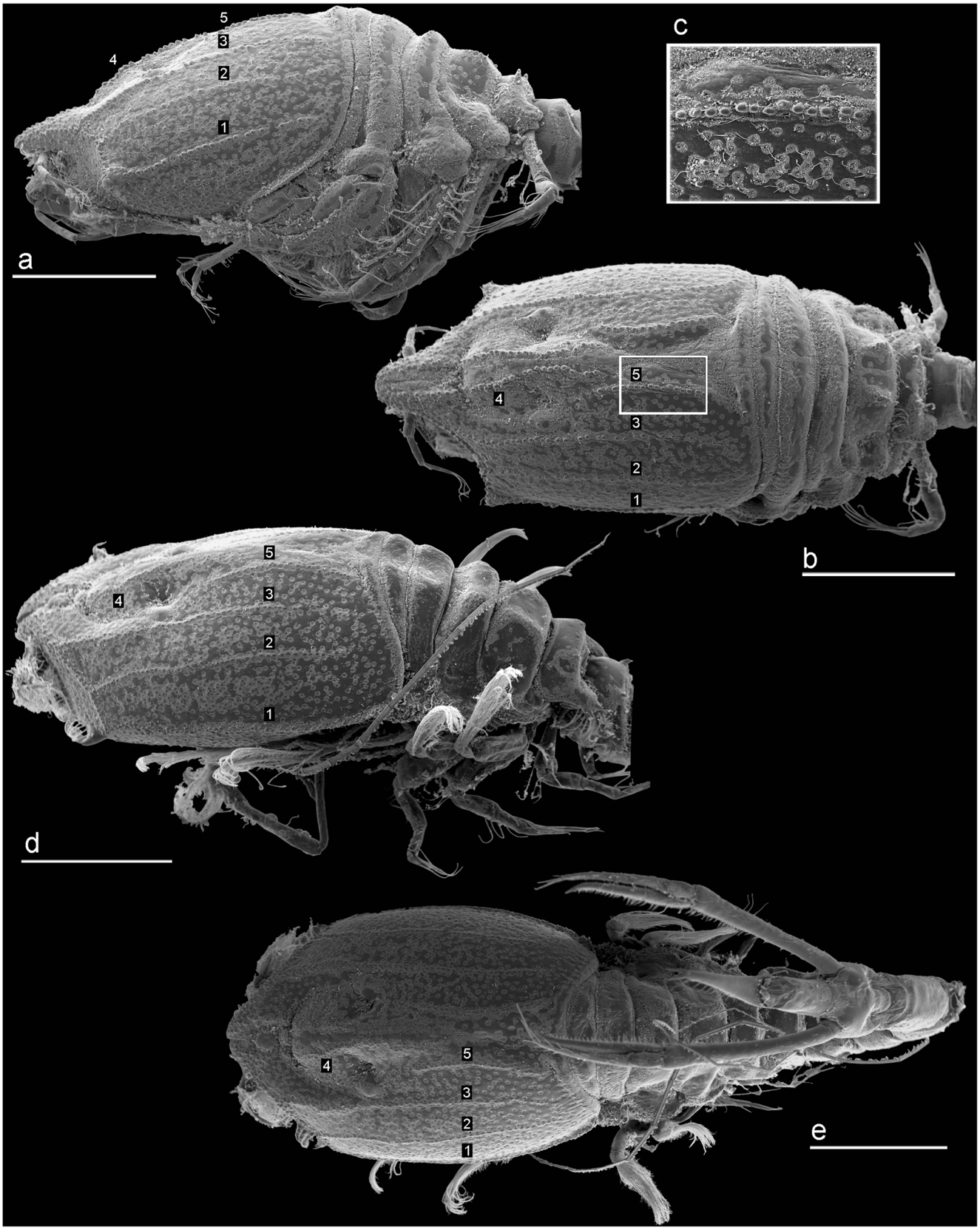

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simple setae only. Carpus 1.9 as long as ischium and merus combined. Dactylus approximately half as long as propodus. Exopod flagellum of seven articles (setae not drawn).

Second pereopod (Fig. 7b). Basis 0.8 as long as remaining articles together, with setulate setae on inner margin and distally and with teeth on outer margin. Ischium with 1 large tooth on inner distal corner. Merus with a row of teeth on outer margin and with 3 setulate setae distally. Carpus to dactylus with simple setae only. Carpus 1.8 times as long as ischium and merus combined. Dactylus slightly longer than propodus. Exopod flagellum of seven articles (setae not drawn).

Third pereopod (Fig. 7c). Basis approximately as long as remaining articles together, with setulate setae and a few teeth. Ischium with 2–3 setulate setae. Merus with simple and setulate setae. Carpus 0.9 as long as merus, with 8–9 simple/barely setulate setae. Propodus with 1 simple seta distally. Dactylus with 1 short simple seta at approximately half-way along article and 2 simple setae (1 minute, 1 large) distally. Without exopod.

Fourth pereopod as third except for: basis 0.7 as long as remaining articles together.

Fifth pereopod (Fig. 7d). Basis 0.6 as long as remaining articles together, with setulate setae. Ischium with 2 setulate setae. Merus with simple and setulate setae. Carpus 0.9 as long as merus, with 8 simple/barely setulate setae. Propodus with 1 simple seta distally. Dactylus with 1 short simple seta at approximately half-way along article and 2 simple setae (1 minute, 1 large) distally. Without exopod.

Telson (Fig. 7e) 1.6 times as long as last pleonite (excluding distal cuspidate setae), pre-anal part 1.2 times as long as post-anal part, each side with 5–6 cuspidate setae with sensory tip, distal end with 2 cuspidate setae.

Uropod (Fig. 7e). Peduncle 1.3 times as long as telson (excluding distal cuspidate setae), with 9–11 short (weak cuspidate?) setae on inner margin. Endopod of two articles: first article approximately as long as second, with 3 cuspidate setae with sensory tip on inner margin; second article with 4–5 cuspidate setae with sensory tip on inner margin and 1 cuspidate seta with sensory tip distally. Exopod 1.3 times as long as endopod, with 2 rows of short simple setae along article and 2 long simple setae distally.

Description of the adult male (based on paratype MACN-In. 39824b and MACN-In. 39824c)

Total length (paratype MACN-In. 39824b): 8.6 mm (because the pleon is arched, its length was estimated by summing individual pleonite lengths).

Carapace (Figs. 8a, b and 10d, e) as in female except for 1.3 times as long as wide. Inferior row of blunt tubercles more prominent. Ocular lobe approximately as long as wide. Lower margin finely serrated. Antero-lateral angle absent.

Pereon (Figs. 8a, b and 10d, e) 0.7 as long as carapace.

Pleon (Fig. 8a) as in female.

First antenna (Fig. 8c). Peduncle as in female except for: thicker, first article 1.2 times as long as second and third combined, second article 1.6 times as long as third. Main flagellum of six articles, first article the widest and carrying a brush bearing around a hundred thin aesthetascs (only 3 of them drawn), third article the longest, second to fourth articles with many simple setae, fifth and sixth articles with 1 aesthetasc each, sixth article with simple setae distally. Accessory flagellum reaching distal end of third article of main flagellum; of four articles, third article the longest, fourth minute.

Right and left (Fig. 8d) mandibles, first and second maxillae and first maxilliped as in female.

Second maxilliped. As in female except for: basis approximately as long as remaining articles together. Merus 0.7 as long as carpus. Propodus, inner margin with 14–15 barely setulate setae and 5 setulo-serrulate setae.

Third maxilliped. As in female except for: basis 1.8 times as long as remaining articles together. Merus 0.6 as long as carpus. Carpus approximately as long as propodus, with 5 setulate setae on or near inner margin. Propodus with 8–10 setulate setae on inner margin. Dactylus 0.85 as long as propodus. Exopod larger, flagellum of seven articles.

First pereopod (Fig. 9a). As in female except for: basis 0.9 as long as remaining articles together, with fewer setulate setae. Carpus 1.7 as long as ischium and merus combined. Dactylus 0.6 as long as propodus. Exopod larger, flagellum of eight articles (setae not drawn).

Second pereopod (Fig. 9b). As in female except for: basis thicker, 0.9 as long as remaining articles together, with setulate setae on both margins. Merus with teeth on both margins and with 4 setulate setae. Carpus 1.9 times as long as ischium and merus combined, with 7 serrulate setae on inner margin and distally. Exopod larger, flagellum of eight articles (setae not drawn).

Third pereopod (Fig. 9c). Basis approximately as long as remaining articles together, with 2 teeth distally and several setulate setae. Ischium with 2–3 setulate setae. Merus with simple and setulate setae, and small teeth. Carpus 0.7 as long as merus, with 7–8 simple setae and small teeth. Propodus with 1 simple seta distally. Dactylus with 1 short simple seta at approximately half-way along article and 2 simple setae (1 minute, 1 large) distally. Exopod large, flagellum of eight articles (setae not drawn).

Fourth pereopod as third except for: basis 0.8 as long as remaining articles together, with several teeth. Carpus with 8–9 simple/barely setulate setae.

Fifth pereopod as in female except for: basis with fewer setulate setae. Carpus slightly longer than merus, with 6–7 simple setae.

First pleopod (Fig. 9d). Basis with 5 coupling setae and 5–6 setulate setae on inner margin, and short simple setae on

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anterior surface. Exopod of two articles, second article with 4 long setulate setae. Endopod of 1 article, with 6 long setulate setae.

Second pleopod. As first except for: basis, inner margin with only 4 coupling setae. Endopod with 2 short and 4 long setulate setae.

Telson (Fig. 9e) 2.4 times as long as last pleonite (excluding distal cuspidate setae), pre-anal part 0.7 as long as post-anal part, each side with 8–10 cuspidate setae with sensory tip, distal end with 2 cuspidate setae.

Uropod (Fig. 9e). Peduncle 1.1 times long as telson (excluding distal cuspidate setae), with 17–19 bipectinate setae on inner margin. Endopod of two articles: first article 0.7 as long as second, with 10–11 bipectinate setae on inner margin; second article with 18–20 bipectinate setae on inner margin and 1 cuspidate seta with sensory tip distally. Exopod 1.1 times as long as endopod, with 2 rows of short simple setae along article and 2 long simple setae distally.

Etymology. The species epithet refers to the ten horizontal rows of blunt tubercles on its carapace.

Distribution. Off the coast of Buenos Aires Province, between 51 and 61 m depth.

Remarks

Diastylis decalineata n. sp. most closely resembles *Diastylis argentata* Calman, 1912, *Diastylis granulata* Zimmer, 1921, and *Diastylis sexpectinata* Alberico and Roccatagliata, 2011. These four species share the following features: two articles on uropod endopod, a pair of antero-lateral horns (corni) on carapace, and lack exopods on the female pereopods 3 and 4. *Diastylis fimbriata* Sars, 1873 from Brazil may be another candidate to be included in this group, however, the carapace of this species apparently does not have antero-lateral horns. In contrast, the male of *D. geocostae* Băcescu and Petrescu, 1991 has such horns but instead of being associated with the infero-lateral ridges these horns are joined by two oblique ridges enclosing a flat anterior area or *plateau*. Thus, although this species has two articles on uropod endopods and lacks exopods on female pereopods 3 and 4, it does not seem to be closely related to the four species above mentioned.

Among all the four species mentioned earlier *Diastylis decalineata* n. sp. is most similar to *Diastylis sexpectinata*. In these two species both males and females have a horizontal row of teeth running back from the antero-distal horn (this row is missing in the females of *D. granulata* and *D. argentata*).

Furthermore, *D. decalineata* n. sp. can be easily separated from *D. sexpectinata* by the following: (1) mid-dorsal surface of carapace with two anterior and two posterior horizontal rows of tubercles (in *D. sexpectinata* these four rows are absent or at most the two anterior rows are barely developed, *see* Alberico and Roccatagliata 2011, figure 8B), (2) pseudorostrum with a distinct arched row of tubercles (absent or barely developed in *D. sexpectinata*, *see* Alberico and Roccatagliata 2011, figure 8A), (3) upper lateral and arched rows are joined (the upper lateral row starts behind frontal lobe fissure), (4) female pseudorostrum wide in dorsal view (bottleneck-shaped in *D. sexpectinata*), (5) lower margin of female carapace serrate (crenulate in *D. sexpectinata*) and (6) carapace surface glabrous and clean (hairy and usually covered with detritus in *D. sexpectinata*).

Diastylis decalineata n. sp. and *D. sexpectinata* co-occurred in the three stations sampled off the coast of Quequén (*see* the list of material examined herein and in Alberico and Roccatagliata 2011).

Discussion

Diastylis is the oldest of all cumacean genera. It has a large number of species (about 100) but still there is no satisfactory way to split this genus in two or more natural groups.

Stebbing (1912, 1913) created the genus *Holostylis* (and the family Holostylidae) to accommodate those species of *Diastylis* with uniarticulate uropodal endopod. Although this family has not been accepted by later researchers, *Holostylis* is considered to be a valid genus (*see* Day 1980; Błażewicz-Paszkowycz and Heard 2005).

Currently, the genus *Holostylis* contains three species: *H. helleri*, *H. spinicauda* and *H. uniramosa* n. sp. The habitus of these three species is quite similar: they are large and their integument is heavily calcified and ornamented with conical tubercles. However, the females of these three species are easily distinguished from each other taking into account the number of thoracic appendages with fully developed exopods: three in *H. helleri,* one in *H. spinicuada* and none in *H. uniramosa* n. sp. (Zimmer 1909; Petrescu and Wittmann 2003; Błażewicz-Paszkowycz and Heard 2005; this contribution).

In the context of cumacean taxonomy, the number of exopods has been used not only as diagnostic characters of genera but also subfamilies (e.g., the exopods are restricted to third maxilliped and first pereopod in the Bodotriinae) and families (e.g., missing on the third maxilliped in females of Gynodiastylidae). Females entirely without exopods (and males with five pairs of exopods) are found in the genera *Allodiastylis*, *Haliana*, *Dayus* and *Zimmeriana* (Gynodiastylidae), and *Elassocumella* and *Normjonesia* (Nannastacidae). Within the family Diastylidae, the females of *Paradiastylis* lack exopods on maxilliped 3 but they have fully developed exopods on pereopods 1–2.

The variation observed in the number of fully developed exopods in the females of *Holostylis* is at odds with the accepted practice for the definition of the genera in Cumacea.

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However, it is evident that *H. helleri*, *H. spinicauda* and *H. uniramosa* n. sp. are closely related species, and we found no reason to erect a new genus for each of them.

Błażewicz-Paszkowycz and Heard (2005) considered that *H. helleri* displays the ancestral character (female with fully developed exopods on maxilliped 3 and pereopods 1 and 2) and *H. spinicuada* the derived one (female bears fully developed exopods only on maxilliped 3). If this trend is also valid for *H. uniramosa* n. sp., it becomes the most derived species of the genus. We can also speculate that the female of *H. uniramosa* n. sp. is the most sedentary (with the lowest swimming capacity) of the three species.

Stebbing (1912, 1913) created the genus *Ekdiastylis* (and the family Ekdiastylidae) to accommodate those diastylids with biarticulate uropodal endopods. However, neither this family nor this genus has been recognized by later authors, except for Ledoyer (1993) who suggested maintaining *Ekdiastylis* as a subgenus of *Diastylis*. *Diastylis decalineata* n. sp., *D. argentata* (already included by Stebbing in *Ekdiastylis*), *D. granulata* and *D. sexpectinata* not only have 2-jointed uropodal endopods, but also a strong horn on each side of the carapace and no exopods on female pereopods 3 and 4. The genus *Diastylis* needs a thorough revision based both on morphological characters and molecular data. Only then might the taxonomic position of the above mentioned four species be clarified. At present, we prefer to keep them within the genus *Diastylis*.

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