Larval development of *Minyocerus angustus* (Dana, 1852) (Decapoda: Anomura: Porcellanidae) under laboratory conditions

Hernández[1], G.; Graterol, K.; Magán, I.; Bolaños, J.; Lira, C.; and Gaviria, J. I.

Universidad de Oriente, Núcleo Nueva Esparta, Isla de Margarita, Venezuela.
[1] Apartado postal 074 - La Asunción Isla de Margarita - Venezuela, e-mail: gonzalo@c-com.net.ve

Abstract

The two zoeal stages and megalopa of *Minyocerus angustus* are described and illustrated on the basis of specimens obtained from 11 females collected in shallow waters at Punta Arenas beach (Cubagua Island, Venezuela), and reared in the laboratory. *Minyocerus angustus* hatches as a prezoea of less than 90 minutes´ duration and then molts through two subsequent zoeal stages of 7-9 and 10-11 days´ duration, respectively, at 25 °C and 38 ‰ salinity, before attaining the megalopa. The telson of both zoeal stages is notably spoon-shaped, so much that their spines appear to be displaced ventrally rather than laterally, as customary for this taxon. Nevertheless, since the fifth pair of major telsonal setae of the zoea I are inserted outside the central prominence, and the zoea II exhibits an additional pair of major setae, *M. angustus* should be included in the Lebour´s larval *Porcellana* Group. The two zoeal stages of *M. angustus* are compared with those of *Polyonyx gibbesi*, *Porcellana sayana*, and *P. sigsbeiana*, which are the only Caribbean species within the Porcellana Group whose larval morphology description is available. The megalopa of *M. angustus* exhibits the adult's typical antennae, with movable articles minute and flagellum rudimentary.

Key words: Zoea, megalopa, *Minyocerus*, Porcellanidae, larval development.

Introduction

The Porcellanidae is a group of small size crabs either free-living or symbionts with other invertebrates, distributed throughout the tropical and temperate regions of all the oceans. This family has been artificially divided into lots based on adult characteristics. One of these lots is comprised by those genera having the basal article of antenna produced forward and broadly in contact with the anterior margin of carapace, so that movable segments are far removed from orbit, and includes the American representatives *Polyonyx* Stimpson, 1858, *Porcellana* Lamarck, 1801, *Pisidia* Leach, 1820, *Megalobrachium* Stimpson, 1858, *Ulloaia* Glassell, 1938, and *Minyocerus* Stimpson, 1858, according to Haig (1960).

Larval evidences supporting the adult-based relations above mentioned are restricted to the former four genera, whilst complete early postembryonic morphology for *Ulloaia* and *Minyocerus* is just about unknown, since only the first zoeal stage of *Minyocerus angustus* has been described (Hernández *et al.*, 1996).

The genus *Minyocerus* contains only two species, one on either side of the American continent: *M. kirki* (range: Gulf of California to Nicaragua), and *M. angustus* (range: Honduras, Panama, Colombia, and from Venezuela to Florianopolis, Brazil). The latter has been recorded as symbionts of several echinoderm species (*viz.* brittle and sea stars), but specially those of the genus *Luidia*, by Gore and Shoup (1968).

In the present study, the complete larval development of *M. angustus* is described and illustrated. The two zoeal stages of this species are compared with those of more closely related porcellanid species from the Caribbean and whose larval morphology is available (*i.e. Polyonyx gibbesi*, *Porcellana sayana*, and *P. sigsbeiana*).

Materials and Methods

Eleven ovigerous females of *M. angustus* were collected at Punta Arenas (northern coast of Cubagua Island, Southeastern Caribbean), depth 3 - 4 m, as symbionts of the sea star *Luidia senegalensis*, transported to the laboratory, and kept individually in 300-ml glass containers with filtered seawater (38‰ salinity, room temperature) and fed daily with live *Artemia* adults.

After hatching the females were removed and preserved in 4% formalin. Larvae were reared individually in 120 ml filtered seawater (25,0 ± 0,2 °C, and 38‰ salinity) and fed daily the rotifer *Brachionus plicatilis* and/or new hatched nauplii of *Artemia*. Water was changed after each daily examination of cultures for dead larvae and evidence of molting. Samples of specimens and/or exuviae of each stage were preserved in a 1:1 mixture of glycerol and 4% formaldehyde solution. The observations and drawings were made using an Olympus BM-50 binocular microscope equipped with an Olympus U-IT120 drawing tube. Terminology for the different types of setae, and methods for measuring carapace length (CL) and width (CW), rostral spine length (RSL), and posterior spines length (PSL) follow Hernández *et al.* (2000); the arithmetic means of measured specimens and their standard deviations were estimated. Distribution of chromatophores and coloration of the specimens were determined on live specimens. Counts and setal formulae were determined from proximal to distal location on each article. Dorsal setae on the endopodite of maxillipeds 1 and 2, and apical setae of the scaphognathite were designated with Roman numerals.

Results

The porcellanid crab *M. angustus* hatches as a prezoea which persist less than 30 minutes, and then molts through two subsequent zoeal stages before the megalopa is reached. Morphology of zoeal stages and megalopa is described below.

Minyocerus angustus (Dana, 1852)
Figs. 1-10

First zoea

Size— CL 0.88 – 1.00 mm (mean 0.94 ± 0.03 mm; n= 10). RSL 4.48 – 5.25 mm (mean 4.87 ± 0.25 mm; n=10). PSL 2.50 – 2.84 mm (mean 2.60 ± 0.09 mm; N=10). 8 specimens examined; 10 specimens measured. Duration: 7-9 days.

Carapace (Fig. 1A)— Typical porcellanid, with 3 pairs of short setae dorsally. Postocular spines absent; ventral margins unarmed. Rostral spine extremely elongated, 4.8 – 5.5 times CL, with numerous short blunt spinules over entire length, but the apex unarmed (Figs. A_1, A_2, A_3). Posterior spines 2.6 – 3.0 times CL, with 4-7 spinules on proximal third. Eyes sessile.

Antennule (Fig. 2A)— Uniramous, elongated. Exopodite narrowing distally, with 3 unequal aesthetascs, 2 setulose setae and 1 smaller simple seta at distal end.

Antenna (Fig. 3A)— Biramous. Endopodite fused with protopodite, with 1 simple seta subterminally. Exopodite 3.5 times as long as endopodite, bearing serrations in two rows distally.

Mandibles (Fig. 4A)— Asymmetrically dentate. Incisor processes each with 2 acute teeth; molar processes roughened. Palp absent.

Maxillule (Fig. 5A)— Coxal endite with 9 setae (6 setulodenticulate, 3 setulose). Basial endite with 10 setae (6 denticulate, 4 setulose). Endopodite unsegmented, with 1+2 setulose seta; mesial spine absent. Exopodite absent.

Maxilla (Fig. 6A)— Coxal and basial endites bilobed, with 7,6 and 7,8 setulose setae on proximal and distal lobe, respectively. Endopodite unsegmented, with 3+2+4 setulose setae. Scaphognathite with 6+I setulose setae plus microtrichia as illustrated.

Maxilliped 1 (Fig. 7A)— Biramous. Coxopodite with 2 setulose setae. Basipodite with 1+2+2+3 setulose setae ventrally. Endopodite 4-segmented with 3,3,4,10+I setulose setae; microtrichia on articles 1-3 dorsally. Exopodite indistinctly 2-segmented, with 4 setulose setae terminally.

Maxilliped 2 (Fig. 8A)— Biramous. Coxopodite without setae. Basipodite with 1+2 setulose setae. Endopodite 4-segmented with 2,3,4,10+1 setulose setae; microtrichia on articles 1-3 dorsally. Exopodite indistinctly 2-segmented, with 4 setulose setae terminally.

Maxilliped 3— Present as undifferentiated buds.

Pereiopods— Present as undifferentiated and rudimentary buds.

Abdomen (Fig 10A)— Five somites, none with prominent posterolateral spines. Posterodorsal margin entire. Pleopods absent.

Telson (Fig. 10B,G)— Longer than broad. Notably spoon-shaped, lateral spines spinulose, somewhat ventrally located. Anomuran hair present. Five pairs of major setuloserrate setae (serrations short and straight); fifth pair not inserted on central prominence; latter concave, with a pair of simple setae. Dorsal setae and anal spine absent.

Color in life— Rostral and posterior spines orange almost over entire length. Abdominal somites each with an orange chromatophore.

Second zoea

Size— CL 1.35 – 1.45 mm (mean 1.41 ± 0.03 mm). RS 5.88 – 6.23 mm (mean 6.05 ± 0.10 mean). PSL 2.50 – 2.84 mm (mean 2.60 ± 0.09 mm). 10 specimens measured; 6 specimens examined. Duration: 10-11 days.

Carapace (Fig. 1B)— Dorsal setae and ventral margins invariable. Rostral spine 4.2 – 5.1 times CL, with scarce low spinules Fig. B_1). Posterior spines 1.8—2.6 times CL, with few low spinules (Fig. B_2). Eyes stalked.

Antennule (Fig. 2B)— Biramous. Protopodite with 2 short setae at midlength of outer margin; 4 short setae just proximal to base of exopodite. Endopodite unarmed, 0.5 times as long as exopodite. Exopodite with 4,4,3,3 aesthetascs plus 4 setae terminally.

Antenna (Fig. 3B)— Endopodite half as long as exopodite, with 1 seta subterminally. Serrations on exopodite now fewer.

Mandibles (Fig. 4B)— Slightly larger than in first zoea, and teeth now more numerous and conspicuous. Palp absent.

Maxillule (Fig. 5B)— Uniramous. Coxal and basal endites each with 12 setae. Endopodite unsegmented, with 1+3 setulose setae. Exopodite absent.

Maxilla (Fig. 6B)— Biramous. Coxal endite with 8,7 setulose setae on distal and proximal lobe, respectively. Basial endite with 9,10 on distal and proximal lobe, respectively. Endopodite invariable. Scaphognathite with 25-26 setulose setae; microtrichia as illustrated.

Maxilliped 1 (Fig. 7B)— Biramous. Coxopodite and basipodite as in first zoea. Endopodite now with setal formula 3+0,3+I,4+I,10+I, (all setulose). Exopodite indistinctly 2-segmented, with 10 setulose setae terminally.

Maxilliped 2 (Fig. 8B)— Biramous. Coxopodite and basipodite as in first zoea. Endopodite now with setal formula 2+0,3+I,4+I,10+I (all setulose). Exopodite as in maxilliped 1.

Maxilliped 3 (Fig. 9A)— Biramous. Endopodite elongate, segmentation incipient, without setae. Exopodite with 4 setulose setae.

Pereiopods (Fig. 9A)— Non functional buds; first pair with chela incipient, last pair reduced.

Abdomen (Fig. 10C)— Five somites; fifth with posterolateral spines. Somites 2-5 each with a pair of pleopods.

Telson (Fig. 10D)— Length more than twice the width; lateral spine and anomuran hair as in first zoea. Now with six pairs of major setae, pairs 1-3 setulodenticulate (Figs. 10H-L, pairs 4-6 setulose (Figs. 10K-L), last pair inserted on central prominence. Dorsal setae and anal spine absent.

Color in life— Ventral margin of rostrum dark orange in color. One red chromatophore on each eyestalks, antennal bases, buccal region, coxopodites of maxillipeds 1-2, and abdominal somites 1-5.

Megalopa

Size— CL 1.13 – 1.14 mm. CW 0.82 – 0.85 mm. 2 specimens measured; 2 specimens examined. Duration: not recorded.

Carapace (Fig. 1C)— CL 1.4 times CW. Dorsal surface with scattered simple setae. Front strongly tridentate in dorsal view, anterior margin serrate, medial tooth advanced (Fig. $1C_1$). Postorbital region spinulose. Eyestalks with 1 seta.

Antennule (Fig. 2C)— Basal article longer than broad, with 2 long spines and series of 6 smaller ones; numerous simple/setulose setae as illustrated. Peduncle 3-segmented, without setae. Ventral ramus 3-segmented, with 3,3,4 simple setae. Dorsal ramus 6-segmented, with 0,3,5,4,3,1 aesthetascs and 1,3,0,0,0,3 simple setae..

Antenna (Fig. 3C)— Basal article strongly produced forward, bearing 17 simple/setulose setae. Peduncle 3-segmented, without setae. Flagellum reduced to 2 articles, first unarmed, second with 3 setae.

Mandibles (Fig. 4C)— Subsymmetrically scoop-like processes; palp 3-segmented, first article with 2 setulose setae, second article unarmed, third article with 13 serrate setae.

Maxillule (Fig. 5C)— Coxal endite with 24 setae (14 setulodenticulate, 10 setulose). Basial endite with 25 setae (14 denticulate, 11 setulose). Endopodite unsegmented, with 1 setulose seta subterminally, apex uneven (Fig. 5D).

Maxilla (Fig. 6C)— Proximal and distal lobes of coxal and basial endites with 31,14 and 21,35 setulose setae, respectively. Endopodite unsegmented, with 1+1 setulose setae. Scaphognathite with 58 marginal setulose setae; dorsal and ventral surface each with 2 short simple setae.

Maxilliped 1 (Fig. 7C)— Coxopodite and basipodite with con 26 and 53 setulose setae. Endopodite unsegmented, with 1 setulose seta, plus 7-9 digitate processes on apex (Fig. 7D). Exopodite with 6 setulose setae.

Maxilliped 2 (Fig. 8C)— Protopodite with 8 setae. Endopodite 5-segmented, with about 4,8,4,15,12 setae. Exopodite 2-segmented; with 9 setae on each article, as illustrated.

Maxilliped 3 (Fig. 9B)— Protopodite with 1 spike-like seta and 16 setulose setae. Endopodite 5-segmented, with approximately the following numbers of setae: ischium, 24; merus, 16; carpus, 14; propodus, 10, dactylus, 11. Exopodite unsegmented, with 4 setulose setae medially and 2 setulose setae terminally.

Pereiopods (Figs. 9C-G)— All legs fully developed, with numerous setae as illustrated. First pair chelate, flattened dorsoventrally; propodus with extensor margin thorny; dactylus with apex curved. Propodus of second pair serrate distally. Fifth pair short, subchelate; propodus and dactylus with 5 and 4 serrate setae, respectively.

Abdomen (Fig. 10E)— Six somites; dorsal surface with numerous simple/setulose setae. One pair of biramous pleopods on each somites 2-5; endopodites with (0,4), (0,4), (0,3) and (1,2) setulose setae and retinacula respectively; exopodites with 6,8,8, and 8 setulose setae. Sixth somite with biramous uropodites; protopodite with 1 or 2 setulose setae; exopodite with about 22 setulose setae; endopodite with 17-21 setulose setae (Figs. 10M-P).

Telson (Fig. 10F)— Incipiently divided into plates. Posterior margin with 18 pairs of setulose setae; dorsal surface with 6 simple setae.

Color in life— One orange-red chromatophore each on frontal, protogastric, and branchial carapace regions, and on merus and carpus of perciopods, and on abdominal somites 2-4.

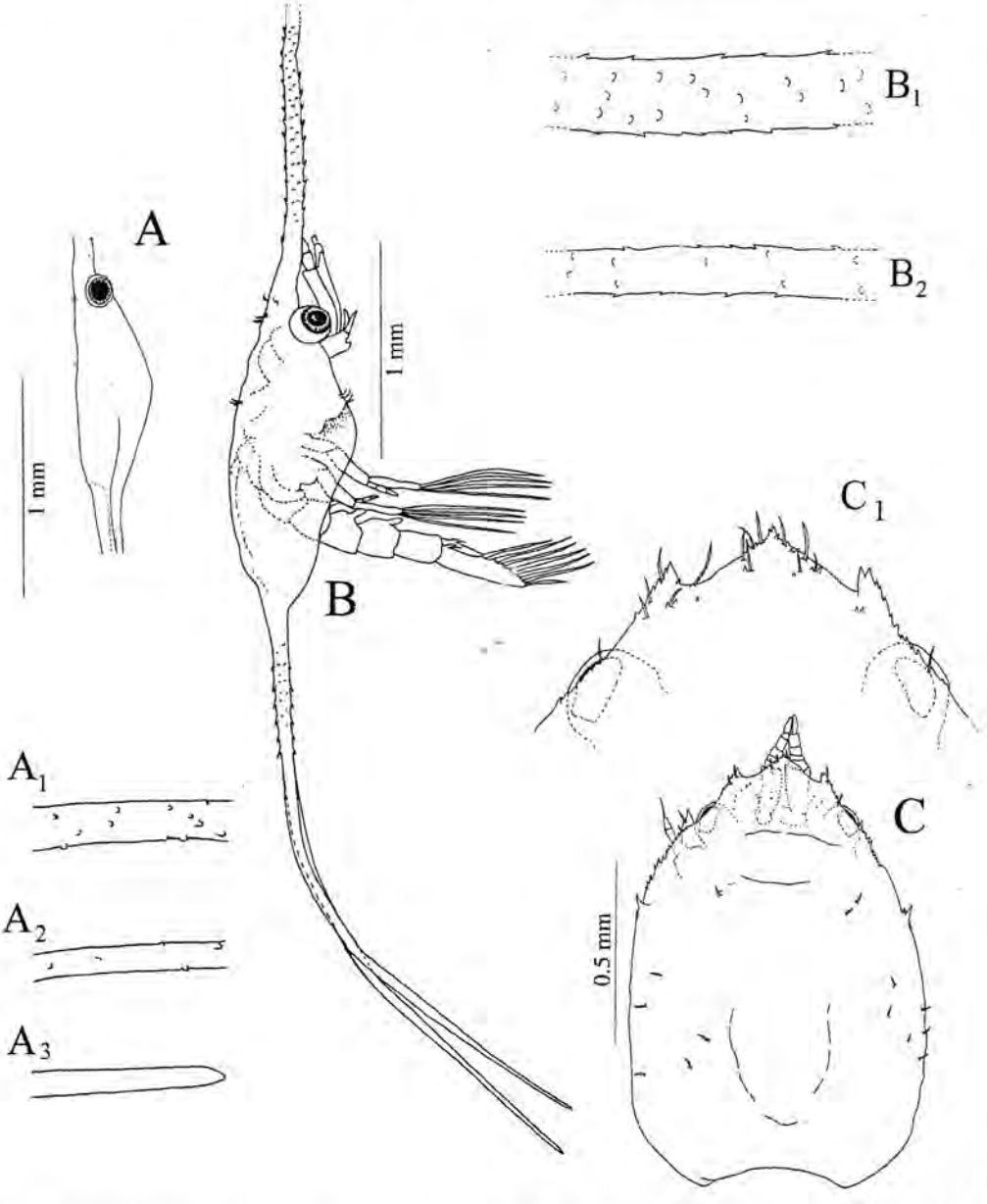


Figure 1: *Minyocerus angustus*. Carapace of first (A) and second zoea (B); detail of proximal (A_1), medial (A_2) and distal portion (A_3) of rostrum of first zoea; detail of rostral (B_1) and posterior spines (B_2) of second zoea; carapace (C) and front of megalopa (C_1).

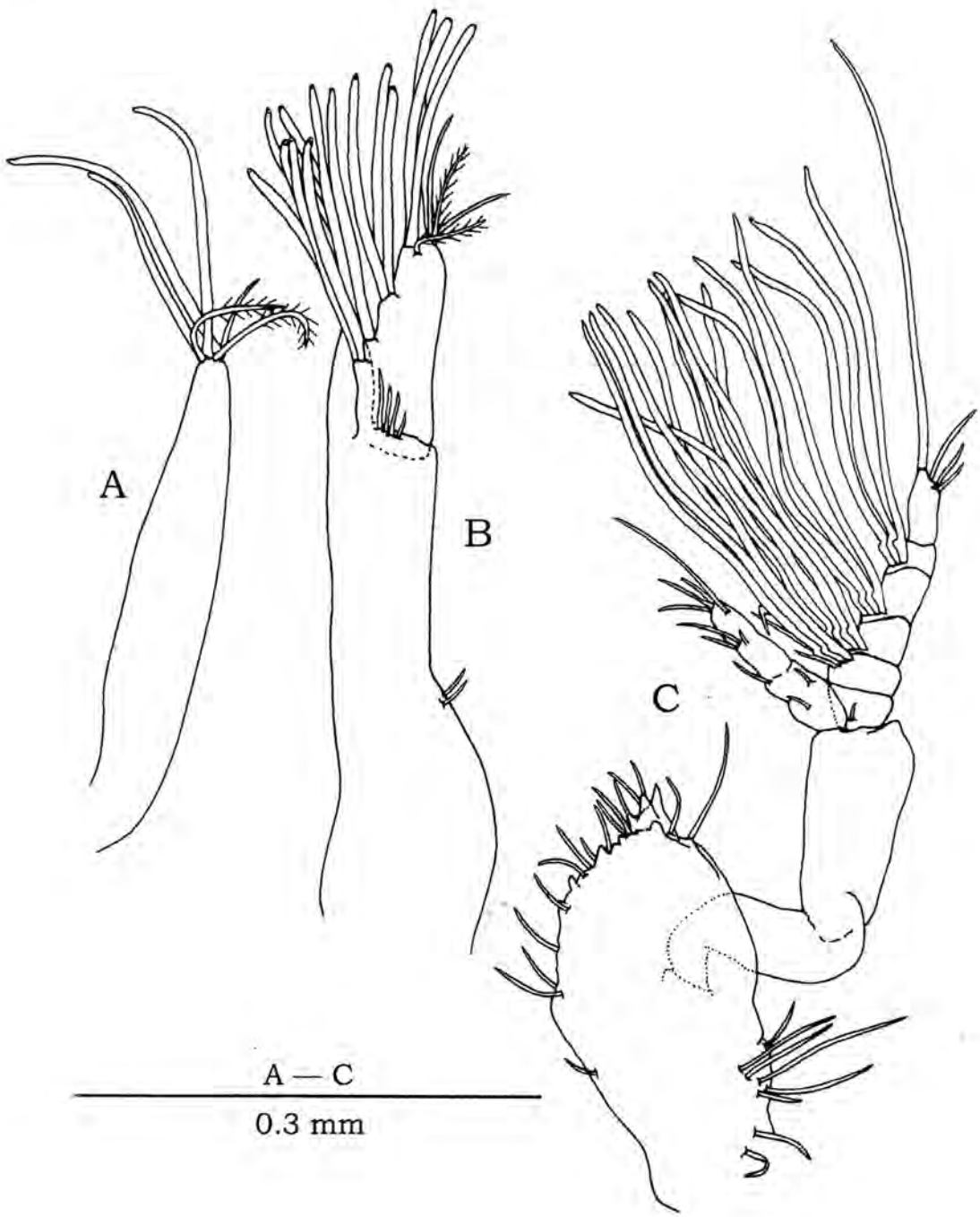


Figure 2:. *Minyocerus angustus*. Antennule of first zoea (A), second zoea (B), and megalopa (C).

Discussion

Hernández *et al.* (1996) described the first zoea of *Minyocerus angustus* based on laboratory-reared material; the culture assayed was not successful because of food quality and larvae did not survive for more than three days. The first zoea of *M. angustus* herein differs from the above

mentioned reported material in the type of major setae on telson, since serrations of the two last pairs of major setae on telson were overlooked by Hernández *et al.* (1996).

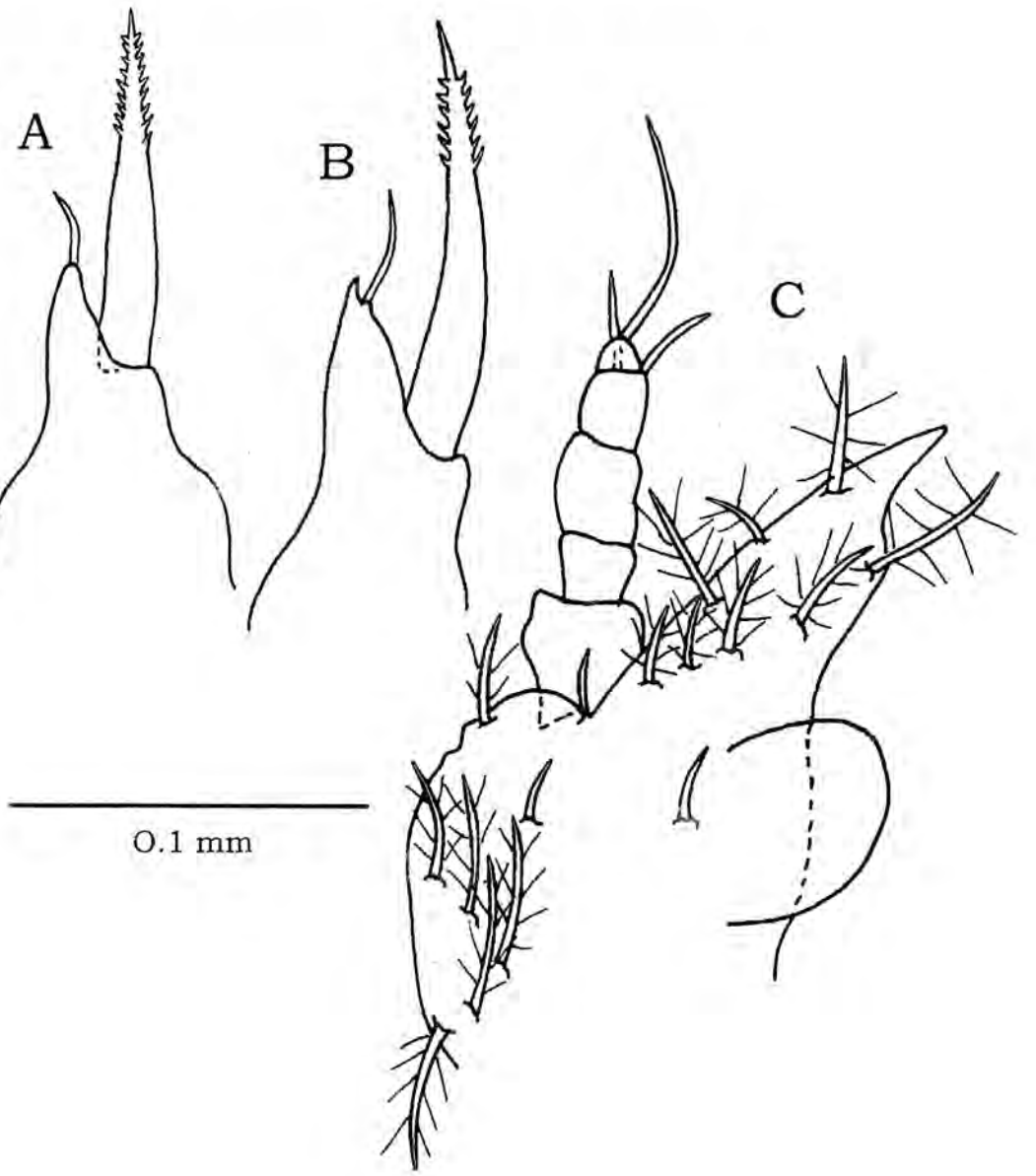


Figure 3: *Minyocerus angustus*. Antenna of first zoea (A), second zoea (B), and megalopa (C).

In *M. angustus* the fifth pair of major setae on telson of first zoea is not inserted on central prominence, and there is an additional pair of major setae on telson of second zoea. These two characteristics compel to place *M. angustus* into the Lebour´s (1943) Group I (or Group *Porcellana*

as named by subsequent authors), which is also constituted by the genera *Euceramus*, *Pisidia*, *Polyonyx*, *Ancylocheles*, and *Porcellana*. Besides *M. angustus*, this group is also represented in the Caribbean by *Polyonyx gibbesi* Haig, 1956, *Porcellana sayana* (Leach, 1820), *Porcellana sigsbeiana* A. Milne Edwards, 1880,, *Pisidia brasiliensis* Haig, 1968, and *Porcellana lillyae* Lemaitre and Campos, 2000, as mentioned by Werding (1977), Scelzo (1982), and Lemaitre and Campos (2000), of which only the larvae of the latter species is unknown (see Gore, 1968, 1971; Werding, 1977; Scelzo, 1982; Hernández *et al.*, 1998 Lemaitre and Campos, 2000).

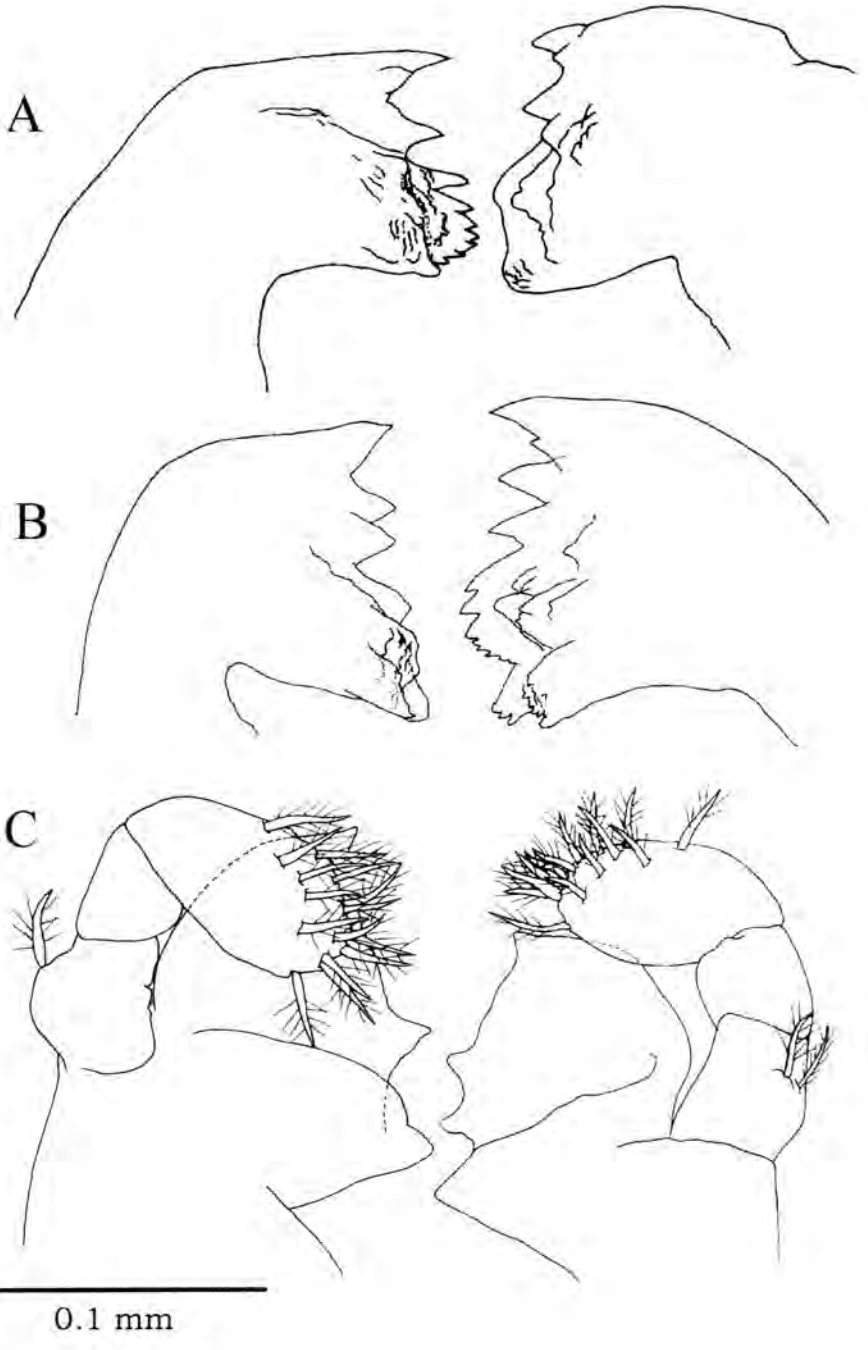


Figure 4: *Minyocerus angustus*. Mandibles of first zoea (A), second zoea (B), and megalopa (C).

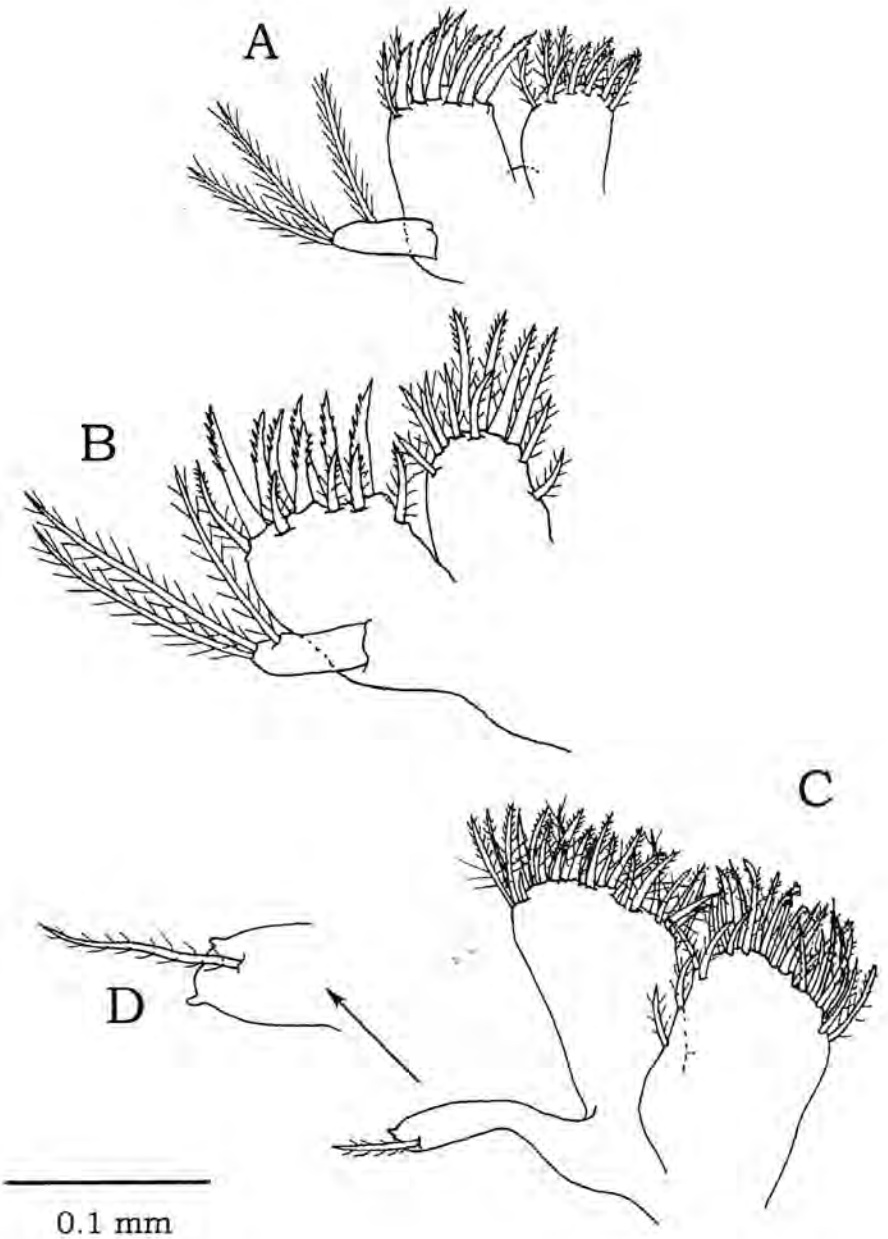


Figure 5: *Minyocerus angustus*. Maxillule of first zoea (A), second zoea (B), and megalopa (C); detail of endopodite of maxillule of megalopa.

These species are closely related not only as a result of their adults' similitude but also because of the morphology of their zoeal phase (see Table I); however, the first zoea of *M. angustus* can be distinguished of those of *Polyonyx gibbesi* (*cf.* Gore, 1968), *Porcellana sayana* (*cf.* Hernández *et al.*, 1998), and *P. sigsbeiana* (*cf.* Gore, 1971) by means of the following aspects: (a) the antennal endopodite-exopodite ratio, (b) numbering of setae on last article of maxilliped 2; (c) absence of either both posterolateral spines on abdomen and anal spine on telson, (d) the

notably spoon-shape of telson, whose spines appear to be displaced ventrally rather than laterally, as customary for Porcellanidae. On the other hand, the second zoea of *M. angustus* is distinguishable of those of *Polyonyx gibbesi*, *Porcellana sayana*, and *P. sigsbeiana* by means of (a) number of of antenullar aesthetascs, and setae on maxillular endopodite, and exopodite of all the maxillipeds, (b) as in first zoea, the antennal endopodite-exopodite ratio, the spoon-shape of telson, and absence of anal spine.

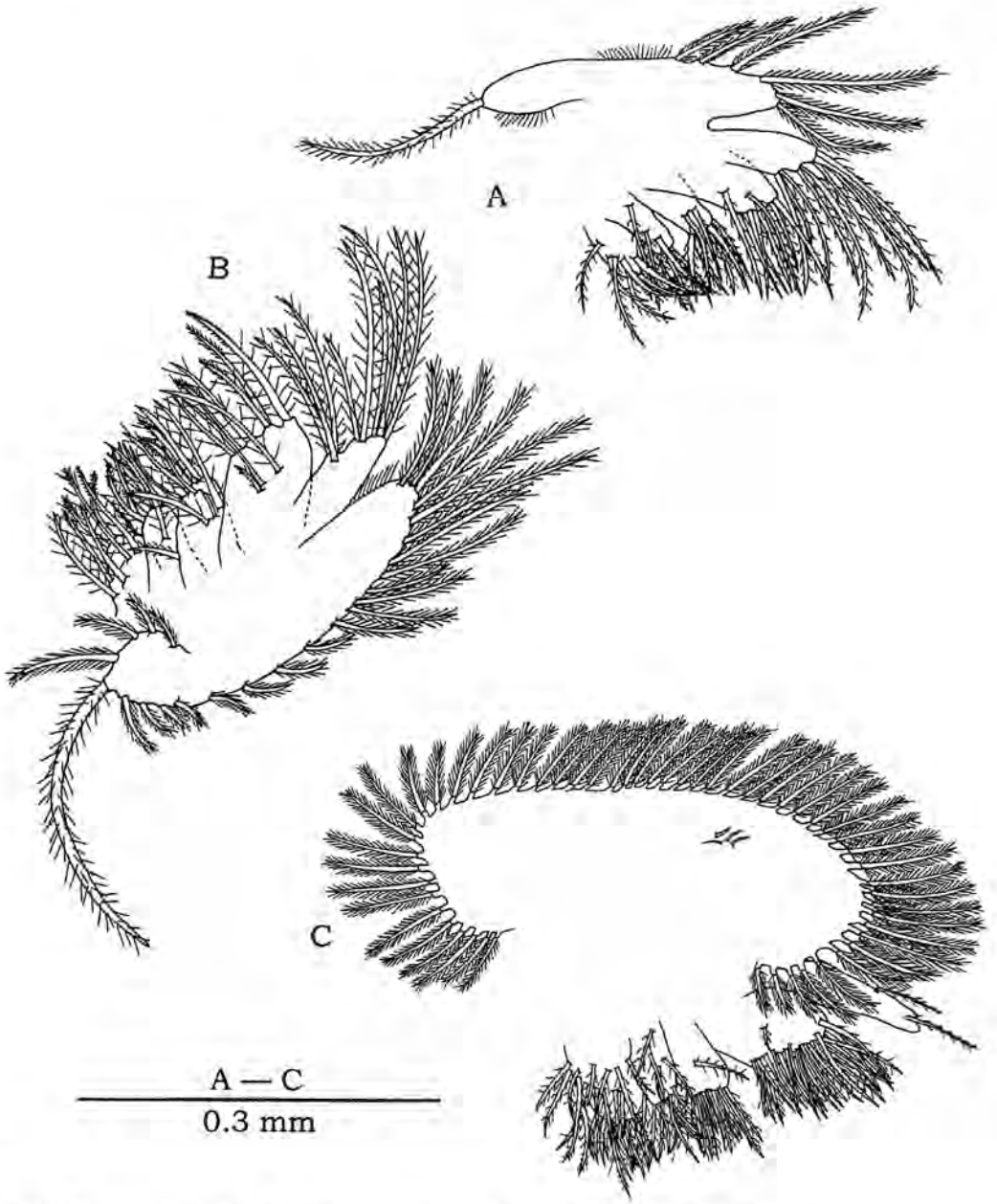


Figure 6: *Minyocerus angustus*. Maxilla of first zoea (A), second zoea (B), and megalopa (C).

The genus *Minyocerus* Stimpson, 1858 was erected to receive *Porcellana angusta* Dana, 1852, because of its striking peculiarities within the genus *Porcellana*: carapace elongate (about 1.3 times as long as broad), and antennal movable articles minute and flagellum rudimentary, their total length scarcely exceeding width of eye, visible only under magnification (Haig, 1960) subsequently a second congeneric species was described (*viz.*, *M. kirki* Glassell, 1938). This

singular antennal type of adults of *Minyocerus* is also present in the megalopa of *M. angustus*, the early ontogenetic changes of this appendage, previous to megalopa, reveal a rare development pattern, in which the length of the exopodite relative to endopodite is atypical, since in most porcellanid species, regardless of what occurs in first zoea, the exopodite is always shorter than endopodite in the second zoea, and *M. angustus* exhibits an inverse ratio, *i.e.* the exopodite is longer than endopodite, which, according to descriptions provided by Knight (1966), also occurs in *Polyonyx quadriungulatus* Glassell, 1935.

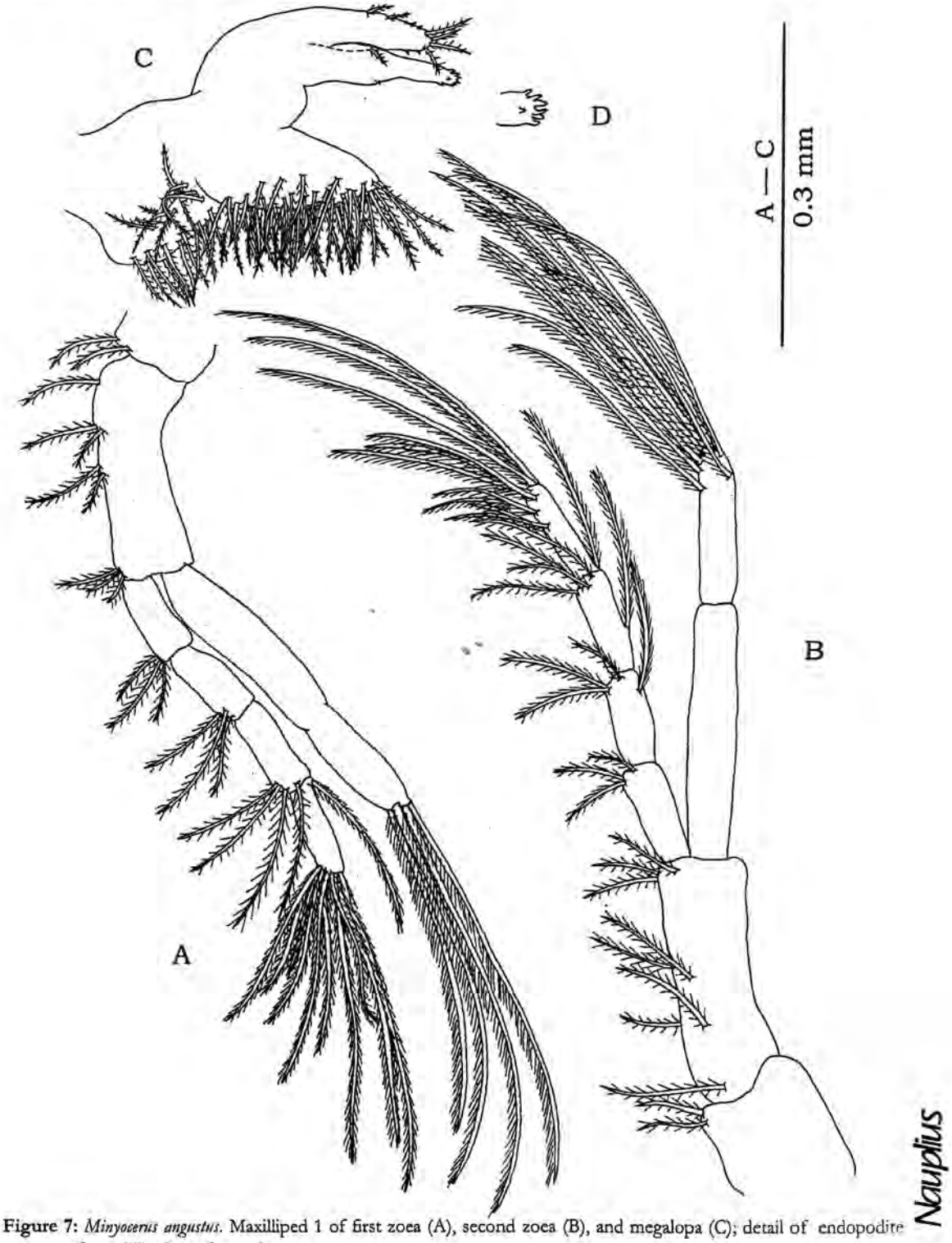


Figure 7: *Minyocerus angustus*. Maxilliped 1 of first zoea (A), second zoea (B), and megalopa (C); detail of endopodite of maxilliped 1 of megalopa.

Table I: Main differences among the zoeas of Caribbean porcellanid species of Lebour's (1943) Group I.

	Minyocerus angustus (present study)	*Polyonyx gibbesi* (*cf.* Gore, 1968)	*Porcellana sigsbeiana* (*cf.* Gore, 1971)	*Porcellana sayana* (*cf.* Hernández *et al.*, 1998)
First zoea				
CARAPACE	CL: 0.94 mm RSL: 5.2 x CL; PSL: 2.8 x CL	CL: 1.20 mm RSL: 7 x CL:; PSL: 1.6 x CL	CL: 1.12 mm RSL: 8 x CL; PSL: 3 x CL	CL: 1.38 mm RSL: 8 x CL; PSL: 2.5 x CL
ANTENNA	Exopodite: 3.5 x endopodite	Exopodite: 2 x endopodite	Exopodite: 1.25 x Endopodite	Exopodite: 2 x Endopodite
MAXILLULE	9 setae on coxal endite	10 setae on coxal endite	9 setae on coxal endite	10 setae on coxal endite
MAXILLA	7,8 setae on basial endite. 6 + I setae on scaphognathite	7,9 setae on basial endite. 5 + I setae on scaphognathite	7, 9 setae on basial endite. 6-7 + I setae on scaphognathite	7, 9-10 setae on basial endite. 6 + I setae on scaphognathite
MAXILLIPED 1 Endopodite	Basipodite without spine. 3,3,4,10+I setae	Basipodite without spine. 3,3,3,10+I setae	Basipodite with spine. 3,3,3,7+I setae	Basipodite with spine. 3,4,4,8+I setae
MAXILLIPED 2 Endopodite	Basipodite without spine. 2,3,4,10+I setae	Basipodite without spine. 2,2,2,10+I setae	Basipodite without spine. 2, 2, 2, 7 + I setae	Basipodite with spine. 2,2-3,2 9+I setae
ABDOMEN	Posterolateral spines absent. Somite 5 without setae	Posterolateral spines present. Somite 5 with 1 pair of setae	Posterolateral spines present. Somite 5 with 1 pair of setae	Posterolateral spines present. Somite 5 with 1 pair of setae
TELSON	Anal spine absent	Anal spine present	Anal spine present	Anal spine present
Second zoea				
CARAPACE	CL: 1.41 mm RSL: 4.6 x CL; PSL: 2.2 x CL	CL: 1.7 mm RSL: 6 x CL; PSL: 1.6 x CL	CL: 1.93 mm RSL: 6.3 x CL; PSL: 4.5 x CL	CL: 2.38 mm RSL: 5 x CL; PSL: 1.3 x CL
ANTENNULE	4,4,3,3 aesthetascs	3,3,2,3-4 aesthetascs	3,3,2,3 aesthetascs	2-3,3,3,3-2,3 aesthetascs
ANTENNA	Endopodite : 0.5 x exopodite	Endopodite : 1.4 x exopodite	Endopodite : 2 x exopodite	Endopodite : 1.2 x exopodite
MAXILLULE	1+3 setae on endopodite	1+2 setae on endopodite	1+2 setae on endopodite	1+2 setae on endopodite
MAXILLA	8,7 setae on coxal endite. 9,10 setae on basial endite	10,7-8 setae on coxal endite. 9,11 setae on basial endite	12, 7 setae on coxal endite. 9, 11 setae on basial endite	10, 7 setae on coxal endite. 9, 11 setae on basial endite
MAXILLIPED 1 Endopodite Exopodite	Basipodite without spine. 3+0,3+I,4+I,10+I setae 10 setae	Basipodite without spine. 3+I,3+I,3+I,11+I setae 12 setae	Basipodite with spine. 3+I,3+I,3+I,9+I setae 12 setae	Basipodite with spine. 3+I,4+I,4+I,10-11+I setae 12 setae
MAXILLIPED 2 Endopodite Exopodite	Basipodite without spine. 2+0,3+I,4+I,10+I setae 10 setae	Basipodite without spine 2+I,2+I,2+I,11+I setae 12 setae	Basipodite with spine 2+I,2+I,2+I,9+I setae 12 or 13 setae	Basipodite with spine 2+I,2+I,2+I,10+I setae 12 setae
MAXILLIPED 3	Exopodite with 4 setae	Exopodite with 6 setae	Exopodite with 6 setae	Exopodite with 5 setae
TELSON	Major setae 4-6 setulose. Anal spine absent	Major setae 4-6 setuloserrate. Anal spine present	Major setae 4-6 setuloserrate. Anal spine present	Major setae 4-6 setuloserrate. Anal spine present

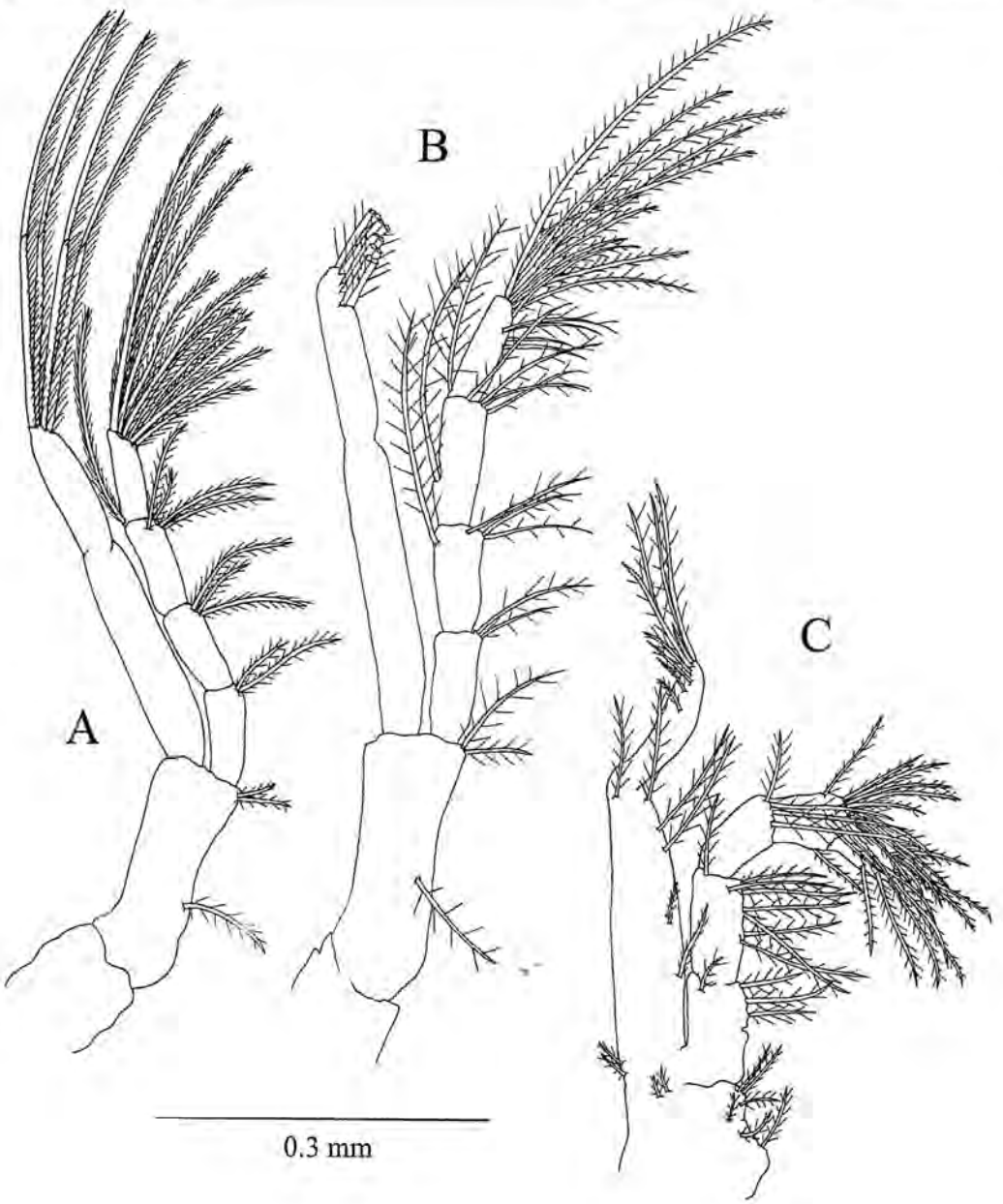


Figure 8: *Minyocerus angustus.* Maxilliped 2 of first zoea (A), second zoea (B), and megalopa (C).

As is the case in adults, the carapace of megalopa of *M. angustus* is more elongated than those of *Polyonyx gibbesi*, *Porcellana sayana*, and *P. sigsbeiana*. It resembles those of the two latter species but not *P. gibbesi*, in having one to several spines on lateral margins of carapace posterior to cervical groove, which are present on adults of the genus *Pisidia* but absent on adults of *Porcellana*. As can be noticed, superficial comparison of the aforementioned morphological aspects could be misleading and yield erroneous conclusions. Therefore, in order to elucidate relationships between these and even other genera, it seems to be necessary to reexamine the

adult-based systematics and larval morphologies, and to undertake concomitantly molecular studies, incorporating other species on a world-wide basis.

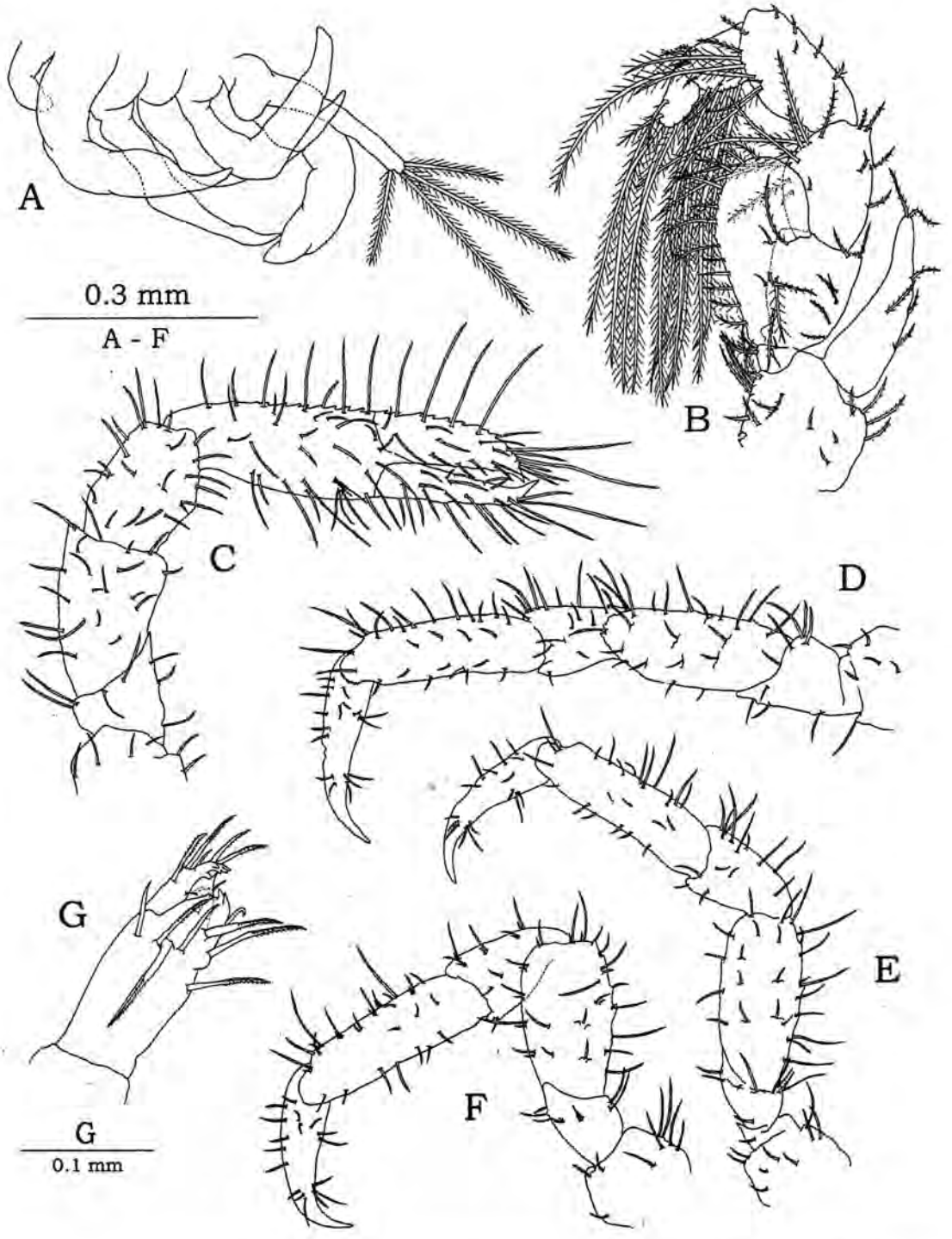
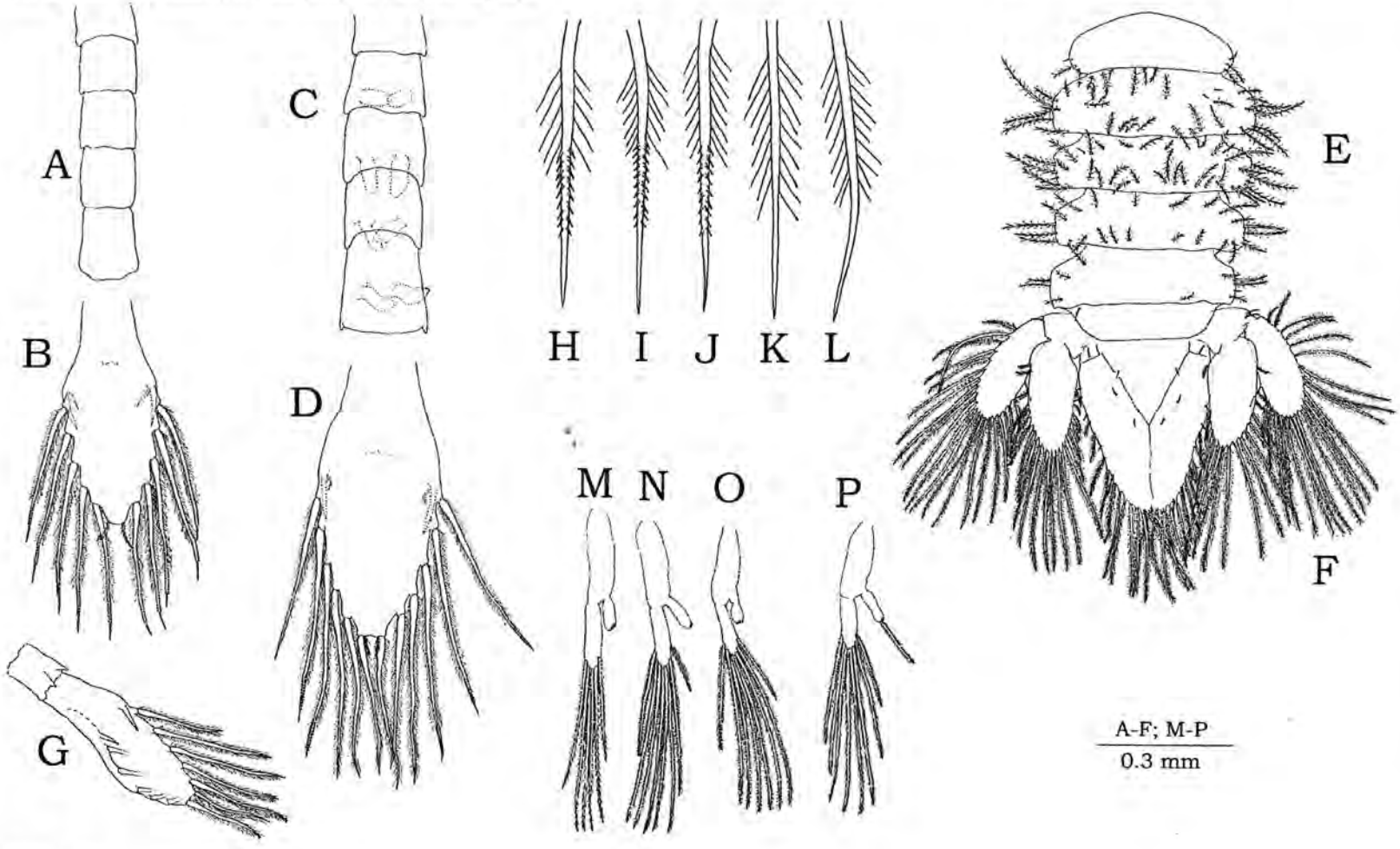


Figure 9: *Minyocerus angustus.* Maxilliped 3 and pereiopods of second zoea (A); maxilliped 3 (B), cheliped (C), pereiopods 2-4 (D-F), and seudochela of pereiopod 5 (G) of megalopa.

Figure 10: *Minyocerus angustus*. Abdomen and telson of first (A,B) and second zoea (C,D); ventrolateral view of telson of first zoea (G); apex of major setae 1-5 of telson of second zoea (H-L); abdomen and telson (E,F), and pleopods (M-P) of megalopa.



Acknowledgements

This study was supported by the Consejo de Investigación, Universidad de Oriente, Venezuela, through the grant CI-4-0901-1018/01. Thanks are indebted to Iván Hernández-Ávila and Pedro Sebastián Rodríguez for their invaluable help when collecting the ovigerous females, and to Jesús Rosas for providing the rotifers and the seawater for larval culture.

References

Gore, R. H. 1968. The larval development of the commensal crab *Polyonyx gibbesi* Haig, 1956 (Crustacea: Decapoda). Biological Bulletin, 135:111-129.

Gore, R. H. 1971. The complete larval development of *Porcellana sigsbeiana* (Crustacea: Decapoda) under laboratory conditions. Marine Biology, 11: 344-355.

Gore, R. H. and Shoup, J. B. 1968. A new starfish host and an extension of range for the commensal crab, *Minyocerus angustus* (Dana, 1852) (Crustacea: Porcellanidae). Bulletin of Marine Science, 18: 240-248.

Haig, J. 1960. The Porcellanidae (Crustacea Anomura) of the Eastern Pacific. Allan Hancock Pacific Expeditions, 24: 1-440.

Hernández, G.; Bolaños, J. and Graterol, K. 1996. Morfología de la primera zoea de *Minyocerus angustus* (Dana, 1852) (Crustacea: Anomura: Porcellanidae). Saber, 8: 87-92.

Hernández, G.; Graterol, K.; Álvarez, A.and Bolaños, J. 1998. Larval development of *Porcellana sayana* (Leach, 1820) (Crustacea: Decapoda: Porcellanidae) under laboratory conditions. Nauplius, 6: 101-118.

Hernández, G.; Bolaños, J.; Graterol, K. and Lira, C. 2000. Larval development of *Petrolisthes politus* (Gray, 1831) (Crustacea: Decapoda: Porcellanidae) under laboratory conditions. Studies on Neotropical Fauna and Environment, 35:143-155.

Knight, M. D. 1966. The larval development of *Polyonyx quadriungulatus* and *Pachycheles rudis* Stimpson (Decapoda, Porcellanidae) cultured in the laboratory. Crustaceana, 10: 75-97.

Lebour, M. V. 1943. The larvae of the genus *Porcellana* (Crustacea, Decapoda) and related forms. J. Mar. Biol. Ass. U.K., 25:721-737.

Lemaitre, R. and Campos, N. H. 2000. *Porcellana lillyae*, new species (Decapoda, Anomura, Porcellanidae), from the Caribbean Sea, with a key to the Western Atlantic species of the genus. Journal of Crustacean Biology, 20: 259-265

Scelzo, M. 1982. Observaciones sobre la presencia y distribución de crustáceos de la familia Porcellanidae (Decapoda, Anomura) en aguas venezolanas y Mar Caribe. Zoología Neotropical, 2: 1129-1146.

Werding, B. 1977. Los porcelánidos (Crustacea: Anomura: Porcellanidae) de la región de Santa Marta, Colombia. Anales del Instituto de Investigaciones Marinas de Punta de Betín, 9: 173-214.

Received: 15th Oct 2004
Accepted: 26th Jun 2005