



## First zoeal stage of *Macrocoeloma subparallelum* (Stimpson, 1860) (Decapoda: Brachyura: Majoidea) described from laboratory hatched material

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### ABSTRACT

The morphology of the first zoeal stage of the decorator crab *Macrocoeloma subparallelum* (Stimpson, 1860) from Cuba is described and compared with the available descriptions for the genus. Among *Macrocoeloma* Miers, 1879 species, the first zoea of *M. subparallelum* can be differentiated only by the number of aesthetascs and setae of the antennule (4 and 2, respectively). Recently, *Macrocoeloma* has been placed as an *incertae sedis* genus in Majoidea, closely allied to other Epialtidae and Pisinae members. The distinct spine in the distal segment of the endopod of the first maxilliped in the zoeal stages of *Macrocoeloma* is similar to what we observe in other Epialtidae genera, a character that supports the recent phylogenetic findings.

### KEY WORDS

Cuba, Pisinae, Epialtidae, Mithracidae, larval development.

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## INTRODUCTION

Majoid crabs, commonly known as decorator or spider crabs, form one of the most diverse groups among brachyurans including nowadays six families with a total of 907 valid species (Davie *et al.*, 2015). It is a superfamily that is distributed throughout nearly all oceans and is well represented, especially in warm regions, with about 239 species in the Americas, 124 species in the western Atlantic, and 115 species in the eastern Pacific (Griffin, 1966; Boschi, 2000).

Among majoids, the genus *Macrocoeloma* Miers, 1879 has been traditionally considered a member of the family Mithracidae; however, recent phylogenetic studies have suggested the exclusion of *Macrocoeloma* from this family, being now an *incertae sedis* group closely allied to other Epialtidae genera (Windsor and Felder, 2014). Currently, there are 14 described species of *Macrocoeloma* (see Ng *et al.*, 2008), of which 10 are distributed in the western Atlantic from North Carolina to Brazil (Melo, 1996; Coelho *et al.*, 2008). The larval development of only two Caribbean species belonging to this genus is known: that of *Macrocoeloma camptocerum* (Stimpson, 1871) and *Macrocoeloma diplacanthum* (Stimpson, 1860). Both have been partially described in the thesis of Yang (1967), and the latter has been re-described by Marques *et al.* (2003).

*Macrocoeloma subparallelum* (Stimpson, 1860) is a western Atlantic species found in the Gulf of Mexico, the Antilles, Venezuela, and in Brazil as far south as the Espírito Santo State, from shallow waters to 25 m deep (Rodríguez, 1980; Melo, 1996; Felder *et al.*, 2009), and appears to prefer coral substrates (Rathbun, 1925). Despite being widely distributed, *M. subparallelum* is rarely collected, with only very few records in the literature (e.g. Rathbun, 1925; Rodríguez 1980; Scelzo and Varela, 1988).

We describe herein the first larval stage of *M. subparallelum* from Cuba and compare it with the available descriptions for the genus.

## MATERIAL AND METHODS

Two ovigerous females of *M. subparallelum* were collected in November 1994 in the beach of Jaimanitas, Havana, Cuba, between 1–2 meters of depth. The ovigerous females were held in an aquarium in a temperature-controlled room ( $24 \pm 2^\circ\text{C}$ ) until hatching, which occurred at night. After hatching, the

zoeas were fixed in 70% ethanol. Twenty specimens of the first zoeal stage were stained using methylene blue, acid fuchsin and/or chlorazol black, and then dissected in a light stereomicroscope Leica Wild M8 for morphological descriptions. For slide preparations polyvinyl lactophenol or Canada balsam were used as mounting mediums. The larval description follows the pattern used in previous works (e.g. Pohle and Marques, 2000; Santana *et al.*, 2003; 2004; Colavite *et al.*, 2014) and the description of setae follows Pohle and Telford (1981), but here included only analysis by light microscopy (LM), using an Olympus CHA equipped with camera lucida. Some of the setae designated as plumose herein may be plumodenticulate due to the lower resolution limits of LM as compared to scanning electron microscopy (SEM). Description guidelines of Clark *et al.* (1998) were generally followed. A minimum of five zoeae were measured for carapace length (from the basis of the rostrum to the posterior margin of the carapace in lateral view) and total length (from the tip of the rostrum to the furcal shaft in lateral view). The adult females were measured for carapace width (CW) including branchiostegal spines.

Specimens of larval stages and the two spent female crabs (CW 24.1 mm and CW 23.95 mm) have been deposited at the GICUDONE – Grupo de Investigación in Carcinología de la Universidad de Oriente, Escuela de Ciencias Aplicadas del Mar, Margarita Island, Venezuela (accession number # GIC-1001).

## RESULTS

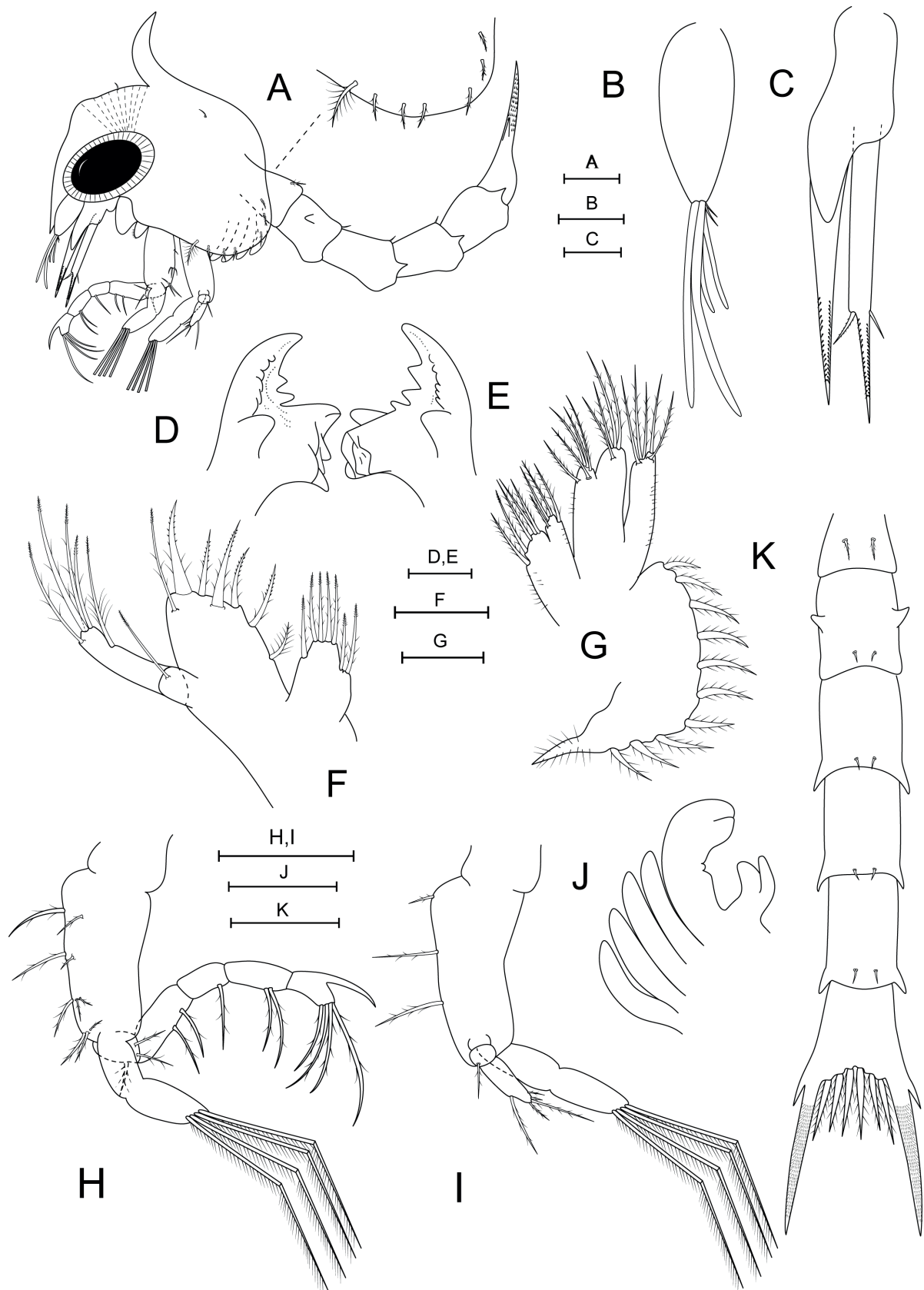
### *Morphological description*

Carapace length.  $0.63 \text{ mm} \pm 0.15$  (0.61–0.65 mm).

Total length.  $2.02 \text{ mm} \pm 0.05$  (1.97–2.07 mm).

Carapace (Fig. 1A). With dorsal spine, curved posteriorly, rostral spine smooth, ventrally directed, almost reaching antenna endopod bud, lateral spines absent. Pair of short simple setae anteriorly just above eyes, simple seta dorsolaterally to dorsal spine. Ventral margin with densely plumose ‘anterior setae’ (Clark *et al.*, 1998) posterior to scaphognathite notch, followed by 5–6 smaller plumose setae. Eyes sessile. Small indistinct prominence frontally between dorsal spine and rostrum bearing cuticular dorsal organ (*sensu* Martin and Laverack, 1992; Lerosey-Aubrill and Meyer, 2013).

Antennule (Fig. 1B). Unsegmented, smooth,



**Figure 1.** *Macrocoeloma subparallellum* (Stimpson, 1860) first zoeal stage. (A) Lateral view; (B) antennule; (C) antenna; (D) mandible, right side; (E) mandible, left side; (F) maxillule; (G) maxilla; (H) maxilliped I; (I) maxilliped II; (J) maxilliped III and pereopods; (K) pleon. Scale bars: A, 0.3 mm; B–G, 0.1 mm.

conical. Terminally with 2 long, 2 shorter aesthetascs, 2 short simple setae.

Antenna (Fig. 1C). Biramous, protopod long, pointed, bearing two rows of sharp spinules; endopod bud approximately less than half of protopod size; exopod unsegmented, slightly longer than protopod, with long spinulated distal process; pair of setae about one third from tip, uneven, one small simple, one larger serrulate.

Mandible (Fig. 1D, E). Asymmetrical, with medial toothed molar processes uneven; enlarged lateral incisor processes; 2–3 marginal teeth between molar and incisor processes. Internal margin of incisor processes with a series of teeth, ending in a larger tooth in both mandibles. Palp absent.

Maxillule (Fig. 1F). Coxal endite with seven setae: four terminal graded plumodenticulate, 3 plumodenticulate subterminally. Basial endite with seven setae: five terminal plumodenticulate cuspidate, one subterminal plumodenticulate, one plumose proximally. Two-segmented endopod, proximal segment with long plumodenticulate seta, distal segment with five long plumodenticulate setae: one subapical, four apical. Exopod seta absent.

Maxilla (Fig. 1G). Coxal endite bilobed, proximal lobe with 4–5 setae: 3–4 plumose, 1 plumodenticulate; distal lobe with five plumodenticulate setae. Microtrichia present on both endites. Basial endite bilobed, proximal and distal lobes with five and four plumodenticulate setae, respectively. Endopod unsegmented, unilobed, with five plumodenticulate apical setae; microtrichia on lateral margin. Scaphognatite marginally with 10–11 densely plumose setae, including distal process.

Maxilliped I (Fig. 1A, H). Coxa without seta. Basis with 10 plumodenticulate setae arranged 2+2+3+3. Endopod 5-segmented with 3,2,1,2,4 plumodenticulate setae, with strong accessory spine on distal segment. Exopod incompletely bisegmented with four plumose terminal natatory setae.

Maxilliped II (Fig. 1A, I). Coxa without seta. Basis with three plumodenticulate setae. Endopod three-segmented, with 0,1,4 sparsely plumodenticulate setae, distal segment with three subapical, two apical setae. Exopod incompletely bisegmented with four plumose terminal natatory setae.

Maxilliped III (Fig. 1A, J). Present as a small bud. Endo and exopod distinct.

Pereopods (Fig. 1A, J). Present as small buds, chela distinct, without apparent segmentation.

Pleon (Fig. 1A, K). Five pleonites. First pleonite with pair of middorsal, long, plumodenticulate setae, pleonites 2–5 with pair of shorter posterodorsal simple setae each. Posterolateral margin of second pleonite with blunt process, pleonites 3–5 with spines; second pleonite with pair of dorsolateral processes. Pleopod buds rudimentary.

Telson (Fig. 1K). Bifurcated, indistinct median notch, three pairs of plumodenticulate setae (Type 13-viii *sensu* Pohle and Telford, 1981) on inner margin; each furcal shaft proximally bearing a distinct lateral spine, furcal shafts covered with rows of spinules to just below the tips.

## DISCUSSION

*Macrocoeloma subparallelum* closely resembles congeners for which the first larval stage has been described. *Macrocoeloma subparallelum*, *M. diplacanthum* and *M. camptocerum* differ only in the number of aesthetascs and setae of the antennule; while the former has 4 aesthetascs and 2 setae, the latter two have 3 and 1, respectively. Another minor difference can be observed in the number of setae in the ventral margin of the carapace: *M. subparallelum* and *M. diplacanthum* have six to seven setae, while *M. camptocerum* has only six (Yang, 1967; Marques *et al.*, 2003).

The larvae of the genus *Macrocoeloma* can be easily recognized through a combination of characteristics including the presence of a distended forehead with strong underlying muscle bands, a dorsal spine, and a distinct, strong spine in the distal segment of the endopod of the first maxilliped (Yang, 1967; Marques *et al.*, 2003). All of these characteristics are present in *M. subparallelum*. As noted by Marques *et al.* (2003), this distinct spine can also be found in other Epiplatidae species, such as *Menaethius monoceros* (Latreille, 1825), *Pugettia* Dana, 1851 and *Huenia* De Haan, 1837 (see Ko, 1998; Kornienko and Korn, 2004; Marques *et al.*, 2003; Colavite *et al.*, 2014).

Majoid crabs have a confusing taxonomic history due to several changes in the status of the families and subfamilies and the lack of substantial characters that support grouping of genera at higher taxonomic levels (Ng *et al.*, 2008). A combination of adult, molecular,

and larval characters could be the best way to find diagnostic characteristics for some groups. Despite the placement of *Macrocoeloma* as an *incertae sedis* group by Windsor and Felder (2014), this genus nested close to other Epialtidae and Pisinae members in their analyses. This is what we observe in the first zoeal stage of this genus, with the distinct spine in the distal segment of the endopod of the first maxilliped. This character is similar to what we see in other Epialtidae genera, which supports the recent phylogenetic studies (Windsor and Felder, 2014). However, Epialtidae is the most speciose family of Majoidea, with 452 recognized species (Davie et al., 2015), and shows a high degree of variability in several larval characters (see Clark and Cuesta, 2015). This could indicate that Epialtidae is not monophyletic in its present composition suggesting the taxonomic reevaluation and additional phylogenetic studies to better define Epialtidae in general and the position of *Macrocoeloma* in particular.

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