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# Larval development of *Petrolisthes magdalenensis* Werding, 1978 (Decapoda : Anomura : Porcellanidae under Laboratory conditions).

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**Résumé** : Le développement larvaire complet du crabe Porcellanidae des Caraïbes du Sud *Petrolisthes magdalenensis* Werding, 1978, a été mené à bien en laboratoire. At 27°C, la forme mégalope est apparue au bout de 9 jours. Le développement consiste en un stade pré-zoé transitoire, deux stades zoé et un stade mégalope. Les larves présentent des caractéristiques au telson qui permettent de les ranger dans le groupe des Petrolisthes, des larves de Porcellanidae.

**Abstract** : The complete larval development of the south Caribbean porcellanid crab *Petrolisthes magdalenensis* Werding, 1978, was carried out under laboratory conditions. At 27°C, the megalopa appeared after 9 days. Development consists in a transitory prezoea, two zoeal stages and a megalopa stage. The larvae exhibit telsonal feature which places them in the Petrolisthes-group of porcellanid larvae.

## INTRODUCTION

The porcellanid genus *Petrolisthes* Stimpson 1858 is represented in the southern Caribbean Sea by 14 species. Of only three of them the complete larval development has been described. The description of further larvae thus would contribute to the establishment of keys for the identification of such larvae from the plancton.

*P. magdalenensis* Werding, 1978, has been described from the northern coast of South America and Central America, ranging from Panama in the occident through the coasts of Colombia and Venezuela to Trinidad and Tobago (Werding, unpubl.). The species lives under stones in the infralitoral from 1/2m to 3m of depth. *P. magdalenensis* belongs to a group of closely related species of *Petrolisthes* which is represented in the western Atlantic additionally by *P. jugosus* Streets, 1872 and in the eastern Pacific by other six species (Haig, 1960). This natural division among american *Petrolisthes* should be considered as a possible separate genus or subgenus after a revision of the whole genus on a worldwide basis. For none of the members of the discussed species group, the larval cycle has been described. Therefore, it would be interesting to know whether the larval morphology might attribute additional criteria for discussing the status of that species group.

## MATERIAL AND METHODS

Ovigerous females were collected from the bay of Santa Marta (Colombia) and transported separately in small quantities of sea water to Giessen (FRG). The animals proved to resist extremely changing temperatures during the travel from Santa Marta (29°C) with a three-day stop over at Bogota with ambient temperatures as deep as 17°C to the Giessen laboratory. In the laboratory the females were held individually in 400 ml beakers in a mixture of natural and artificial seawater at room temperature (21°C +1°C). When haching occurred, 50 larvae were separated in 9 cm plastic dishes containing 50 ccm of artificial sea water. Initially, 10 zoea I were placed in one dish and maintained in an incubator at a constant temperature of 27°C. The cultures were exposed to light only during the daily controls. When the water in the containers was charged, dead larvae and exuviae were removed and larvae were fed with newly hached *Artemia* nauplii. Larvae for subsequent description were stored in 70 % methanol, appendeges were mounted in glycerin and sealed with hot paraffin. Description of coloration and cromatophore distribution is based on living or freshly preserved animals.

### Rearing experiments. (Fig. 1)

Most of the larvae had just passed prezoeal stage when encountered in the recipient where the female was maintained. Recently hached larvae passed to zoea I in less than half a day. Zoeae were separated and placed in the incubator as described above. Temperature rised to the final level of 27°C in a few hours. Most of the larvae molted to the second zoeal stage four days after haching, the rest was molted at the fifth day. Survival from first to second zoea was 96 %. Out of a total of 48 larvae, six were preserved for examination at the eights day of the experiment. Out of the remaining 42 larvae, 14 molted to megalopa between tenth and eleventh day. Seven of the megalopa were fixed at day 13 after haching ; none of the remaining megalopae molted to the subsequent stage as shown in fig. 1, thus the complete duration of the megalopa stage has not been established.

### Description of larvae.

Zoea I (Fig. 2 A, 3 A-H).
Carapace length - 1,4 mm (ten specimens examined).

Typical porcellanid zoea. Rostral spine about 1.8 times length of carapace, armed with scattered, foreward directed spinules. Posterior spines about carapace lenght, curved slightly, without spinulation.

Antennule (Fig. 3 A).
Unsegmented with three terminal aesthetascs and two setae.

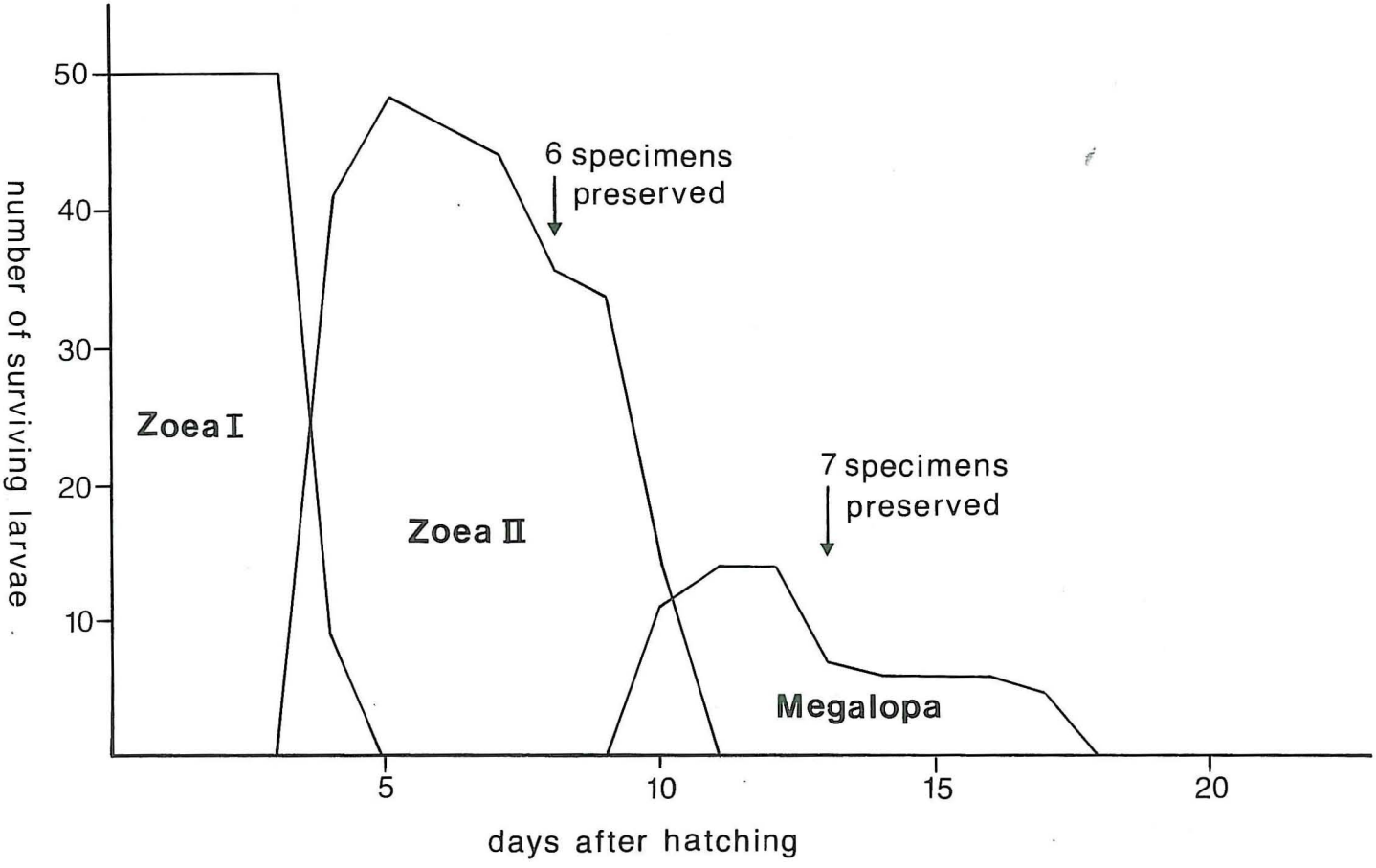


Fig. 1 : Survival of larvae of *Petrolisthes magdalenensis* reared at 27°C in the laboratory.

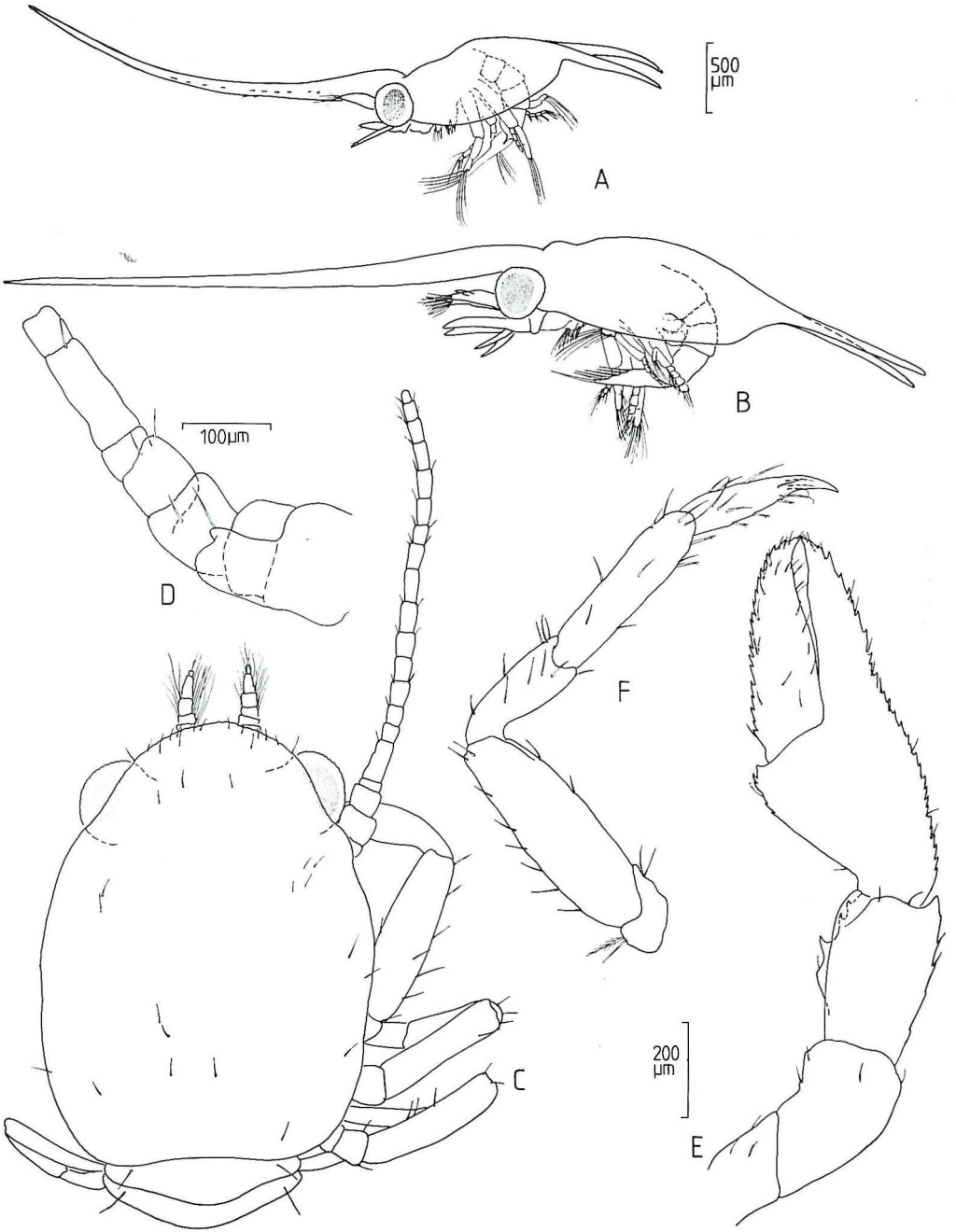


Fig. 2 : *Petrolisthes magdalenensis* : A. Zoea I ; B. Zoea II ; C. dorsal view of Megalopa ; D. detail of basal antennal segments ; E. first pereiopod ; F. second pereiopod.

Antenna (Fig. 3 B)

Biramous, endopodite fused with protopodite, simple ; expodite mobil, overreaching endopodite aproximately 1/4 of its length. Both ramae pointed and with one subterminal seta.

Mandibles (Fig. 3 C).

Assymetric, strongly toothed.

Maxillule (Fig. 3 D).

Endopodite unsegmented, bearing three terminal setae, one of them simple and a small subterminal spinule. Coxal endite with six massive pointed processes and three simple setae. Basal endite with eight setae, two of them simple.

Maxilla (Fig. 3 E).

Endopodite single segmented, with nine setae, four of them simple. Coxal endite with six and six, basal endite with four and six setae on proximal and distal lobes, respectively, placed as illustrated. Scaphognathite with six long plumose marginal setae and an apical one.

Maxilliped I (Fig. 3 F).

Biramous, coxopodite with a pair of setae at inner margin. Basipodite with four groups of 2, 2, 3 and 3 setae on the inner margin. Endopodite four-segmented with 2, 3, 2+3 and 7 setae from proximal to distal segment. An additional large seta on the opposite side of the last segment. Exopodite two-segmented with four terminal natatory setae.

Maxilliped II (Fig. 3 G).

Coxopodite naked. Basipodite with two ventral setae, one at 2/3 of length, the second subterminal. Endopodite four-segmented with 2, 2, 1+2 and 5 seta. An additional large seta on the opposite side of last segment. Exopodite indistincly two-segmented with four terminal natatory setae.

Maxilliped III and pereiopods undeveloped buds which are growing as stage progresses.

Abdomen composed by five somites. Fifth one with a pair of prominent lateral spines.

Telson (Fig. 3 H) with a pair of lateral spines which are accompanied by s small plumose seta each. Five pairs of long plumose setae with thin straight spinules at tips of all of them.

Color : carapace translucent. Rostral spine translucent, at proximal half banded, progressing distally, as follows : faintly orange, transparent, orange, whitish-opaque and ending in an intensly orange colored tip. A small red chromatophore at the base of mandibles, basipodites of maxillipeds II intensely red. A starlike red chromatophore at each side of carapace. Eyes green iridescent.

Zoea II (Fig. 2 B, Fig. 4 A-F, Fig. 5 A-B).

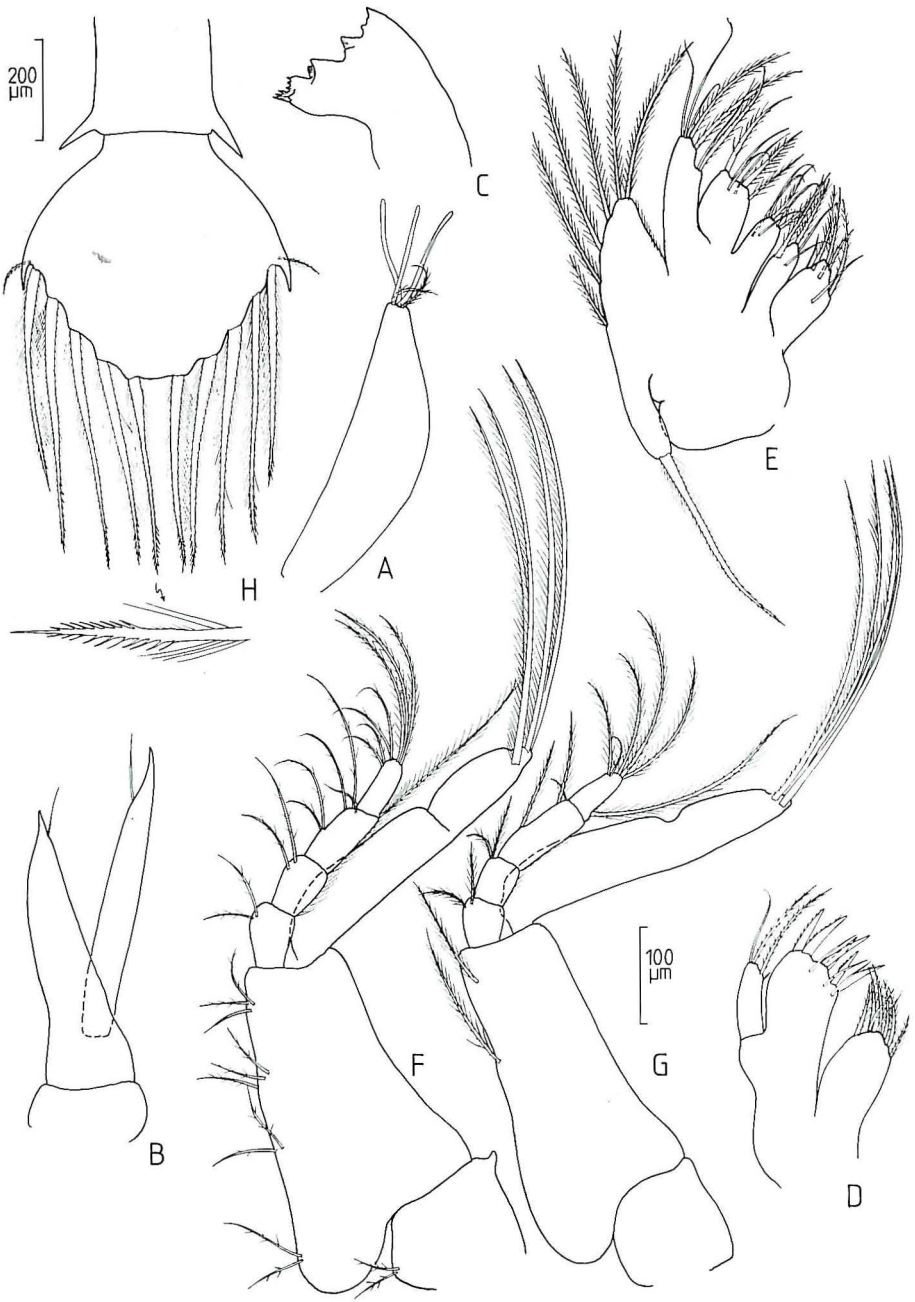


Fig. 3 : *Petrolisthes magdalenensis* : First zoeal appendages and tail fan. A. antennule ; B. antenna ; C. mandible ; D. maxillule ; E. maxilla ; F. maxilliped I ; G. maxilliped II ; H. tail fan with detail of seta ornamentation.

Carapace length 2,0 mm (six specimens examined).

Larger than first zoea. Rostral spine almost straight, reaching about 1 3/4 of carapace length, without spinulation. Posterior spine reaching about 1/2 of carapace length; without spinules.

Antennule (Fig. 4 A).

Biramous, endopodite fused to protopodite, about 1/2 length of exopodite. Exopodite with ten lateral and four terminal aesthetascs and one terminal seta.

Antenna (Fig. 4 B).

Biramous, endopodite longer than exopodite ; both ramae pointed and with one subterminal seta.

Mandibles (Fig. 4 C).

As in first zoea but with additional palp.

Maxillule (Fig. 4 D).

Similar as in first zoea. Endopodite with four terminal setae. Coxal endite with five massive processes and three setae; basal endite with nine setae, three of them simple.

Maxilla (Fig. 4 E).

Single segmented endopodite with 8 setae. Coxal endite with 8 and 6, basal endite with 4 and 7 setae on proximal and distal lobes, respectively, placed as illustrated. Scaphognatite with 11-12 setae on margins and four plumose setae distally.

Maxilliped I (Fig. 5 A).

Setation in coxopodite unchanged as compared with first zoea. Each endopod segment with one plumose dorsal seta. Exopod with eight long natatory setae.

Maxilliped II (Fig. 5 B).

Setae of basis unchanged as compared with zoea I. Endopod now with a long plumose dorsal seta on each segment additionally. Exopod with some ten terminal natatory setae.

Maxilliped III and pereiopods elongated buds which are growing as stage progresses.

Abdomen similar as in first zoea, but with developing pleopod buds on somites 2-5.

Telson (Fig. 4 F) with setation almost identical to foregoing stage but with an additional median spine. Spinulation of terminal setae less pronounced as in first Zoea.

Coloration :

Distribution of cromatophores identical with stade I.

Coloration of eyes less intense.

Megalopa (Fig. 2 D-F, Fig. 6 A-E, Fig. 7 A-G).
Carapace 0.96-0.98 mm x 0.64-0.66 mm (7 specimens examined).

Crablike, carapace suboval, considerably longer than broad, orbitae shallow ; without spines and with only few scattered hair. Frontal region rounded, produced beyond eyes, anterior margin slightly roughened.

Antennule (Fig. 6 A).
Peduncle three segmented, basal segment rounded, outer and upper margin with irregu-

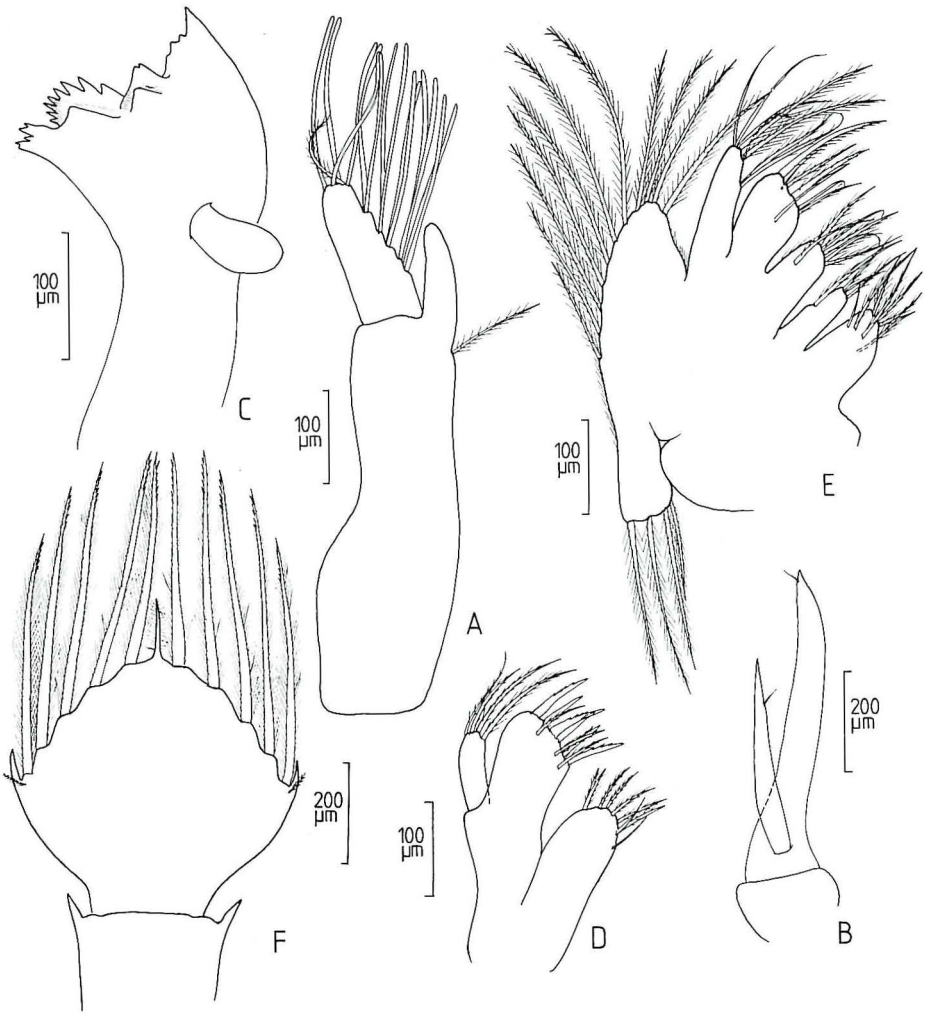


Fig. 4 : *Petrolisthes magdalenensis* : Second zoeal appendages and tail fan. A. antennule ; B. antenna ; C. mandible ; D. maxillule ; E. maxilla ; F. tail fan.

larly set conical tubercles ; setation as drawn. Third segment with one seta near basis of each ramus. Lower ramus four-segmented with some few setae on the first three segments and some eight to ten at the apical one. Upper ramus five-segmented with approximately the following sequence in aesthethascs : one row (6), two rows (4,4), two rows (4,2) one row (4), fifth segment with three smaller subterminal setae and a long terminal one.

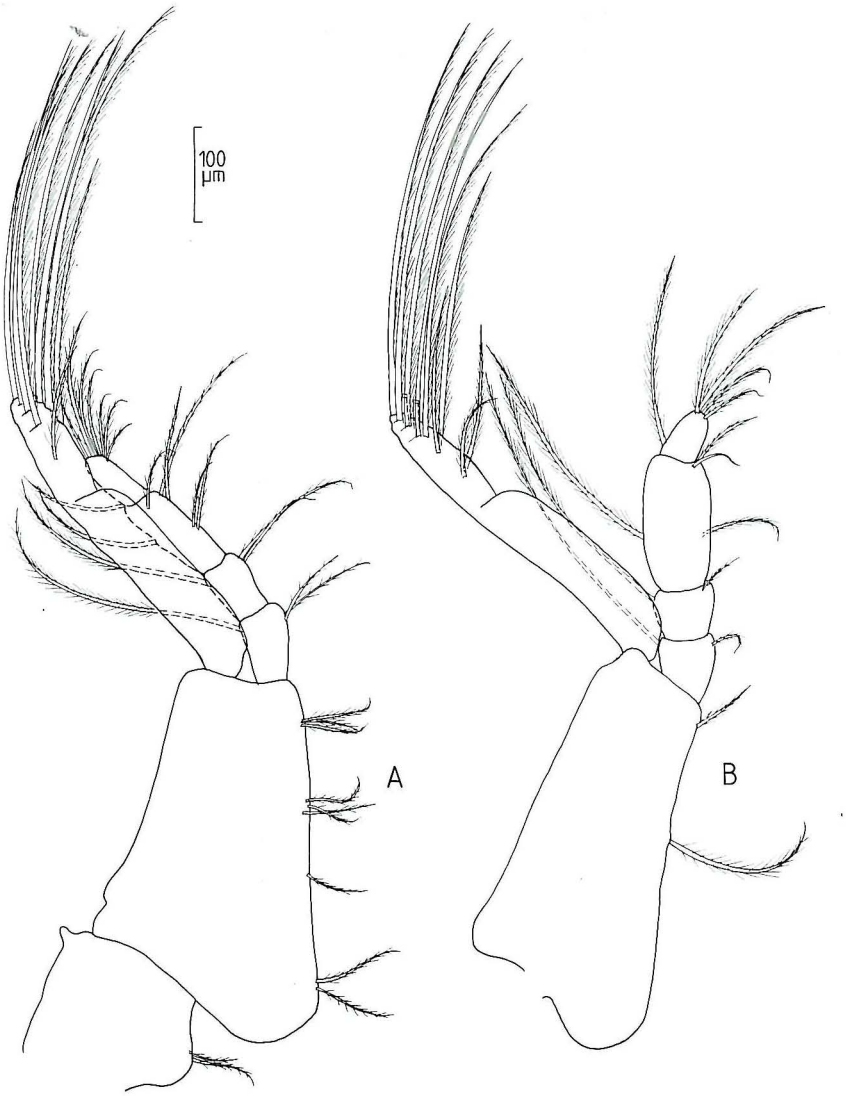


Fig. 5 : *Petrolisthes magdalenensis* : Second zoeal appendages (continued). A. maxilliped I ; B. maxilliped II.

Antenna (Fig. 1 C,D).

First movable segments without denticulation. Flagellum with 18-19 segments, setation irregular and sparse.

Mandible (Fig. 6 B).

Palp 3-segmented, first segment bearing 2 spinules, second unarmed, third with 9 spinules as shown in figure.

Maxillule (Fig. 6 C).

Exopodite unsegmented, with a single subterminal seta. Basal endite with some 22 short spines and setae. Coxal endite with 23 spines and setae approximately ; endite extended to a round hair-fringed lobe.

Maxilla (Fig. 6 D).

Endites with densely set spines and setae partly feathered. Endopod unsegmented with two large subterminal setae ; scaphognathite with 47-50 soft plumose setae around outer margin.

Maxilliped I (Fig. 6 E).

Basis divided into two lobes with about 12 setae on proximal and some 30 on distal lobe. Endopod and exopod unsegmented, latter with three lateral setae.

Maxilliped II (Fig. 6 F).

Endopod five-segmented with numerous plumose setae, progressing distally as follows : 5, 5, 5 at first, second and third segment, 14-15 at fourth and about 25 at terminal segment. Exopod two-segmented, proximal segment bearing four setae on its inner distal surface, distal segment with four large terminal setae.

Maxilliped III (Fig. 7 A).

Biramous, exopodite indistincly two-segmented. Endopod five-segmented. Merus with a double row of long filtering setae (6 + 7 on outer and inner margin, respectively). Following segments similar (carpus 7-8 + 8-9, propodus 10 + 7, dactylus 8 + 6) but with additional smaller setae.

Pereiopods (Fig. 2 E, F ; 7 B).

Cheliped merus with three spines at inner margin, carpus with up to six spines at inner margin, the second is generally the largest one. Additional spines at inner and outer distal angel. Outer margins of chela and movable finger armed with strong curved teeth. Ambulatory legs with scattered setae, merus unarmed. Propodus with two single and a pair of distal movable spines as in adults, dactylus with three movable spines. Fifth pereiopod chelate, gape dentate, with five to six curved cleaning setae plus other setae.


Fig. 6 : *Petrolisthes magdalenensis* : Sensory and feeding appendages of megalopa. A. antennule ; B. mandible ; C. maxillule ; D. maxilla ; E. maxilliped I ; F. maxilliped II.

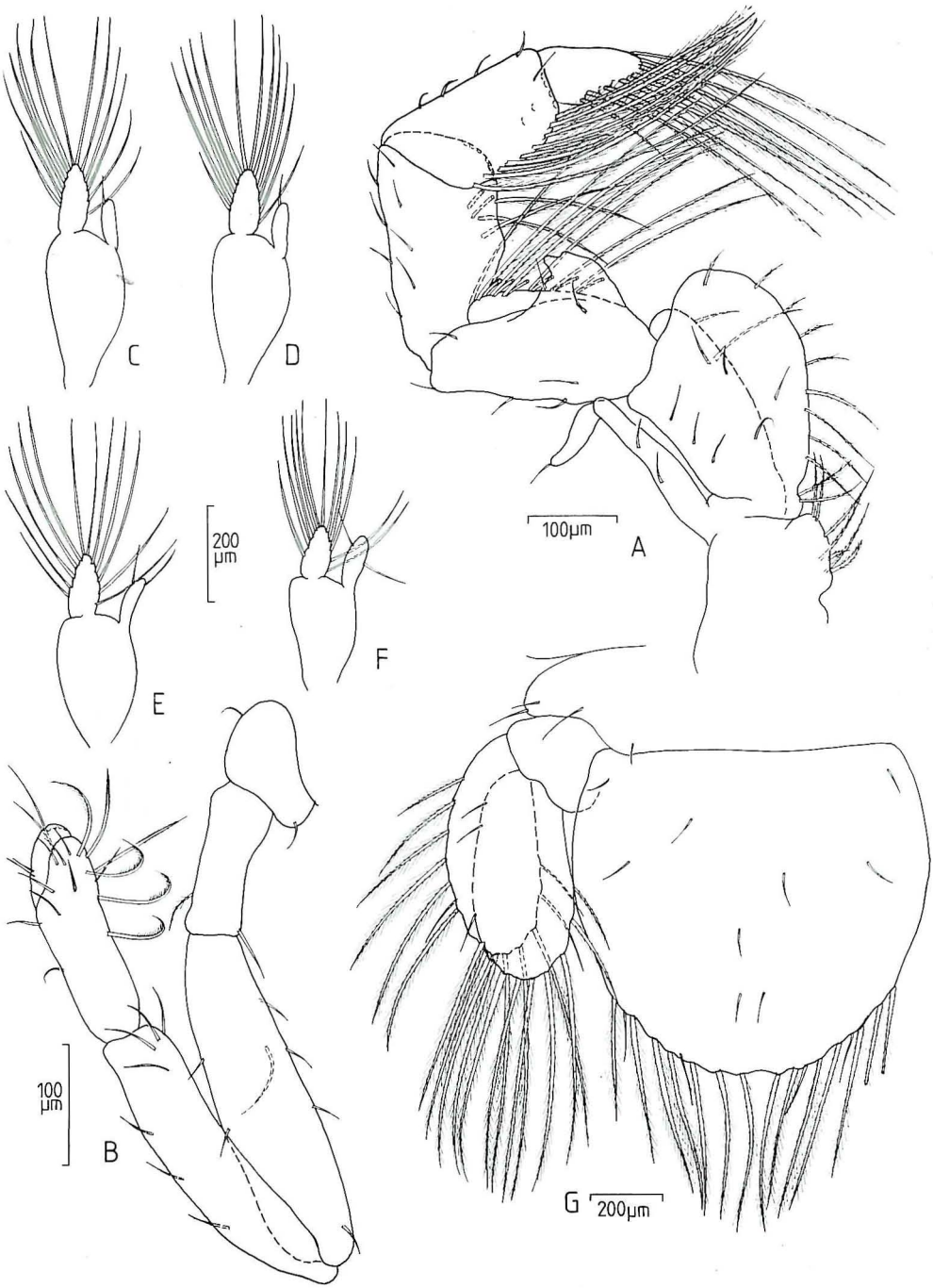


Fig. 7 : *Petrolisthes magdalenensis* : Megalopa. A. maxilliped III ; B. fifth pereiopod ; C.-F. pleopods ; G. tail fan.

Pleopods (Fig. 7 C-F).

Four pairs of simple biramous pleopods present. Exopod with normally 12 setae. Endopod with one or two small setae and with four minute hooks each.

Tail fan (Fig. 7 G).

Telson with seven to eight marginal long plumose setae at either side and a smaller number of shorter setae interspersed. Uropod exopodite with some 15 long setae, endopod with eight to nine.

Coloration :

Megalopa almost colorless, translucent. Eyes with scattered green spots. One red cromatophore at the posterior part of lateral margins of carapace. Buccal cavity with some dispersed red cromatophores. Red cromatophores are also placed in the propodus of third maxilliped, and in the distal part of carpus and propodus of each peraeopod, including chelipeds.

## DISCUSSION

It has been shown by Gore (e.g. 1971a, b) that the duration of the larval stages of tropical porcellanids is to a high degree temperature dependent. As has been discussed by Werding & Müller (in print) for *Neopisosoma neglectum* Werding, 1986, a rearing temperature of 27°C reflects approximately the natural conditions in the Santa Marta area. Thus, under natural conditions, the two zoeal stages do not spent essentially more than some ten days in the plancton. As well as *N. neglectum, P. magdalenensis* belongs to a group of porcellanids with a limited distribution in the southern Caribbean Sea. The restricted spreading capacity of the planctonic larvae is supposed to be one of the reasons for this limitation.

Lebour (1943) subdivided porcellanid larvae using telsonal and mandibular features of zoea. In her *Petrolisthes*-group the median pair of telsonal setae are placed on the central prominence. An additional central spine occurs on the telson of zoea II. Additionally, in the first zoeae of the *Petrolisthes*-group, the mandibles lack palps. Almost all studied *Petrolisthes*-larvae agree with that type. As had to be expected, the larvae of *P. magdalenensis* belong to this division too.

Besides *Petrolisthes,* the larvae of the genus *Pachycheles*, *Neopisosoma* and *Megalobrachium* belong to the *Petrolisthes*-group of larvae and *Clastotoechus* seems to exhibit the same characteristics (Werding, unpubl.). The number of species in the called genus known to occur in the region of Santa Marta amounts to 28 (Werding, 1977, 1978). Of only nine of them, larvae are described. Consequently, distinction of larvae comparing minor details like setation of appedices seems not practicable for the identification of a given larva from the plancton at the actual state of knowledge. Comparing the hitherto known species of the region, the first zoea of *P. magdalenensis* agrees only with that of *P. tridentatus* Stimpson, 1858, in the total lack of a spinulation in the posterior carapace

spines. From that latter larva, *P. magadalenensis* differs in having shorter posterior carapace spines (1 : 1/2) as compared with carapace length (*P. tridentatus* 1 : 1) and in lacking the ventral nubs at those spines as described by Gore (1971b).

For taxonomic considerations as the splitting of the inhomogeneous genus *Petrolisthes* the described larvae of *P. magdalenensis* do not exhibit clearly visible characters which would allow to separate it from the other known larvae of the genus. Possibly, the knowledge of more larvae of the different natural groups of *Petrolisthes* might reveal, by a step by step comparison of minor morphological features, additional criteria for systematic purposes.

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