

STUDIES ON DECAPOD CRUSTACEA FROM
THE INDIAN RIVER REGION OF FLORIDA. II.
MEGALOBRACHIUM SORIATUM (SAY, 1818): THE
LARVAL DEVELOPMENT UNDER LABORATORY
CULTURE (CRUSTACEA: DECAPODA; PORCELLANIDAE)

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ABSTRACT

The larval development of *Megalobrachium soriatum* (Say, 1818), a shallow-water western Atlantic porcellanid crab, is completely described and illustrated. *Megalobrachium soriatum* hatches as a prezoal stage of less than 1 day's duration, and then molts through two subsequent zoal stages of about 6 days' duration each, before attaining megalopal stage. Although megalopae remained as such for up to 8 days, none molted to first crab stage. The zoeae and megalopae of *M. soriatum* are compared with those of two other species of *Megalobrachium* in which the larval development is known. The larvae of all three species, predictably, share many features in common. However, larvae of *M. soriatum* are unusual in that they also exhibit features heretofore known only in larvae of some species of *Pisidia*; a situation all the more remarkable since *Megalobrachium* is a member of the *Petrolisthes*-group of larvae while *Pisidia* is assigned to the *Porcellana*-group of larvae.

INTRODUCTION

The porcellanid crab genus *Megalobrachium*, endemic to the Americas, is represented in the western Atlantic by three species. The larval development for *Megalobrachium poeyi* (Guerin, 1855) has been described previously (Gore, 1971). Of the remaining two species, *Megalobrachium soriatum* is the more common, occurring in shallow water from Cape Hatteras, North Carolina (Williams, 1965) to as far south as Maccio, Brazil (Haig, 1966).

Megalobrachium poeyi had previously been considered conspecific across the Panamanian isthmus. However, studies on the larvae of both populations by Gore (1971) and on the adults from either side of Panama by Gore & Abele (1973) revealed that the eastern Pacific population was specifically distinct, although quite closely related to its previous western Atlantic congener.

An eastern Pacific species, *Megalobrachium tuberculipes* (Lockington, 1878), is very closely related to *M. soriatum* and, according to Haig (1960), the two populations may not be specifically distinct. Consequently, an examination of the larvae from each of these species may be of aid in

determining the true taxonomic status of each, when such larvae become available.

As a means toward this end, the complete larval development from hatching to megalopal stage is described and illustrated for *Megalobrachium soriatum*. The larvae are compared with those of *M. poeyi* and the new eastern Pacific species, *M. pacificum* (see Gore & Abele, 1973), in an attempt to determine features shared by all three. Characteristics exhibited by these and other larvae, as they become known, may not only be of aid in identifying to the generic level such larvae occurring in the plankton, but may also clarify the status and relationships of adults of other species of *Megalobrachium* occurring on either side of the Panamanian isthmus.

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MATERIALS AND METHODS

An ovigerous female collected on 28 June 1972 from a clump of *Oculina* coral 100 m offshore of Vero Beach, Florida, was held in a 19-cm-diameter glass bowl in nonflowing, but aerated, sea water (35‰ salinity) until hatching occurred on 7 July. Individual larvae were placed, one each, in compartments of plastic 24-compartmented rearing trays. Larvae were cultured in the same manner as in previous studies (e.g., Gore, 1971). However, no controlled temperature units were used; the larvae instead were held in water at room temperature, maintained via reverse-cycle closed-system air-conditioning at 25° C ($\pm 1^\circ$ C). Larvae received a sea-water change (35.5‰) and were fed nauplii of *Artemia* every day. Measurements and illustrations of larvae were made as in previous studies, and the measurements given are the arithmetic average of all specimens examined. A very limited series of larvae and the spent female which yielded them are deposited in the National Museum of Natural History, USNM Nos. 141802 and 141803 to 141808.

REARING EXPERIMENT

The larvae of *Megalobrachium soriatum* hatch as prezoae and remain as such for 10 minutes to 1 hour. The duration of the subsequent two zoeal stages was rather regular, requiring 6 days in each stage (Fig. 1). One apparently anomalous second zoea molted to megalopal stage after only 2 days in stage II, but the majority of surviving second zoeae required

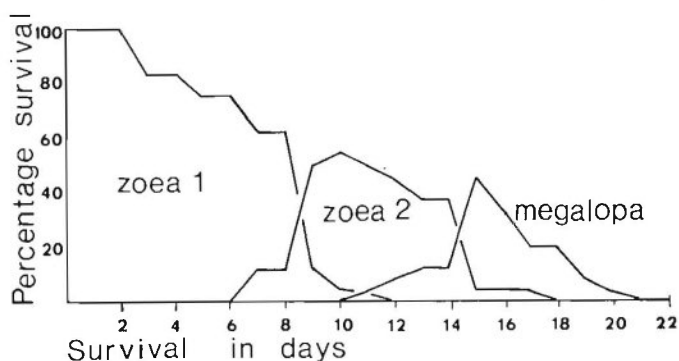


FIGURE 1. Percentage and duration of survival of larvae of *Megalobrachium soriatum* (Say) at room temperature (see text).

6 days to complete this stage. The duration of the megalopal stage is unknown, since none of the postlarvae attained crab stage one. Two megalopae survived 8 days before dying without further molt. All megalopae swam intermittently, but after about 2 days settled to the bottom of the trays and remained there. The megalopae were extremely lethargic once settled and often exhibited little or no activity for long periods of time. It is not known whether inability to feed on swimming nauplii of *Artemia* when settled was a contributing factor in the survival ability of the megalopae. When mouthparts were examined, all appeared normal and undamaged. The reason for further nondevelopment must remain, for the present, speculative.

FIRST ZOEAE

Carapace Length.—1.0 mm.

Number of Specimens Examined.—Five.

Carapace (Fig. 2, A).—Typically porcellanid; rostrum moderately armed with spinules throughout its length, upswept or sigmoid, rarely almost straight, about $2.6 \times$ longer than carapace proper. Posterior carapace spines straight to slightly downcurved, about $\frac{1}{2}$ length of carapace proper, armed ventrally with two or occasionally three large spines, remainder of posterior spine naked or with several very small nubs. Ventral margin of carapace from insertion of posterior spines to just behind antenna distinctly serrate. Carapace with three pairs of thin setae dorsomedially as illustrated. Eyes sessile.

Antennule (Fig. 2, B).—A simple elongate rod; three aesthetascs, three setae as illustrated.

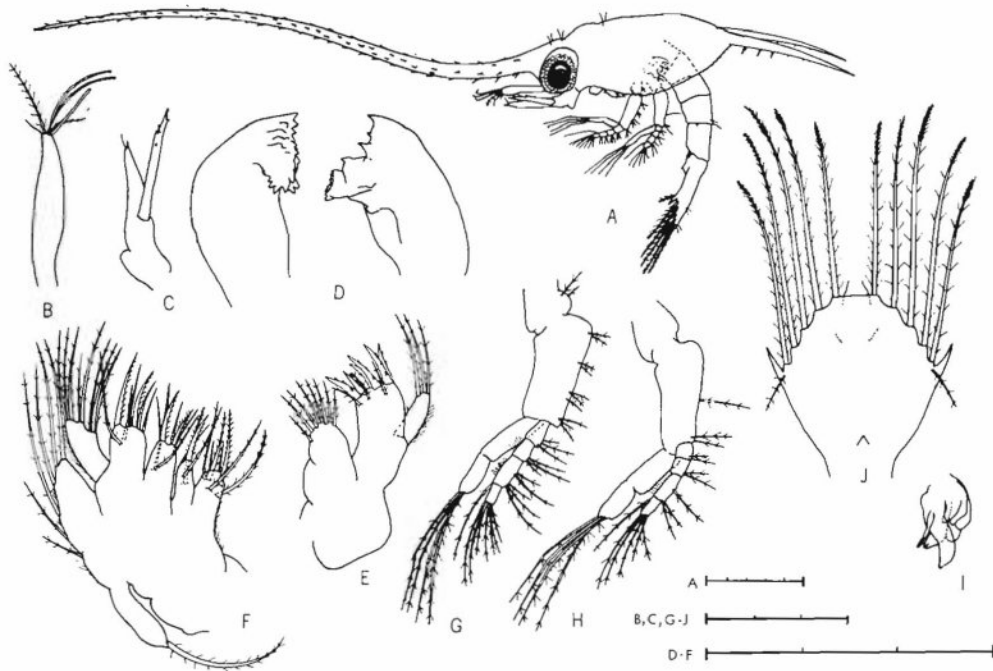


FIGURE 2. *Megalobrachium soriatum* (Say), first zoeal stage and appendages: A, first zoea; B, antennule; C, antenna; D, mandibles; E, maxillule; F, maxilla; G, maxilliped 1; H, maxilliped 2; I, maxilliped 3 and pereopods; J, telson. (Scale-lines equal 0.3 mm or 0.5 mm, according to divisions.)

Antenna (Fig. 2, C).—Exopodite a slender rod, about $\frac{1}{4}$ longer than endopodite, with three spinules distally, but not aligned in a row; spinules sometimes much reduced. Endopodite with single seta terminally as illustrated.

Mandibles (Fig. 2, D).—Heavily chitinized, asymmetrically dentate processes; molar process much roughened; incisor process with spinous teeth below, as illustrated.

Maxillule (Fig. 2, E).—Endopodite a single segment with three long terminal setae and a short thin subterminal spinule; basal endite with five or six spines, three setae; coxal endite with four spines and four spinous setae; latter hardly distinguishable from spines.

Maxilla (Fig. 2, F).—Endopodite a single segment, five terminal (appearing as 3, 2), three subterminal setae. Basal endite with two spines, five setae on each lobe; coxal endite distal lobe, one or two spines, three setae; proximal lobe, four spines, three setae. Scaphognathite usually with six setae around margin and one longer seta apically. Additional fine hairs as illustrated.

Maxilliped 1 (Fig. 2, G).—Coxopodite setae, 2; basipodite setae progressing distally, 2, 2, 3, 3; endopodite setae ventrally progressing distally, 3, 3, 2 + 3, 7 + I (roman numerals = dorsal setae). Exopodite with four natatory setae. Fine setules present on segments as illustrated.

Maxilliped 2 (Fig. 2, H).—Coxopodite naked; basipodite setae, 1, 2; endopodite ventral setae progressing distally, 2, 2, 1 + 2, 5 + I; exopodite with four natatory setae. Fine setules as illustrated.

Maxilliped 3 (Fig. 2, I).—Small generally amorphous buds, without segmentation or setae.

Pereiopods (Fig. 2, I).—As above, slight segmentation and incipient chelation seen.

Abdomen (Fig. 2, A).—Lateral spines on fourth and fifth somites, largest on latter. Two long setae dorsally on somite four. No pleopods.

Telson (Fig. 2, J).—Fifth pair of plumose setae on central prominence of telson; two fine hairs dorsally near prominence margin; plumose processes (telson processes 3-7) appear serrate near tips but lack distinct hooklike spinules. Other setae as illustrated. Anal spine present.

Color.—Zoea totally transparent overall, but with two distinct orange bands near rostral spine-tip, between which appears a white (not transparent) band. Often a lesser whitish band appears proximally to both orange bands. Red-orange chromatophores on basipodites of maxillipeds 1 and 2, and on coxopodite of maxilliped 2. Red chromatophore on mandibular area.

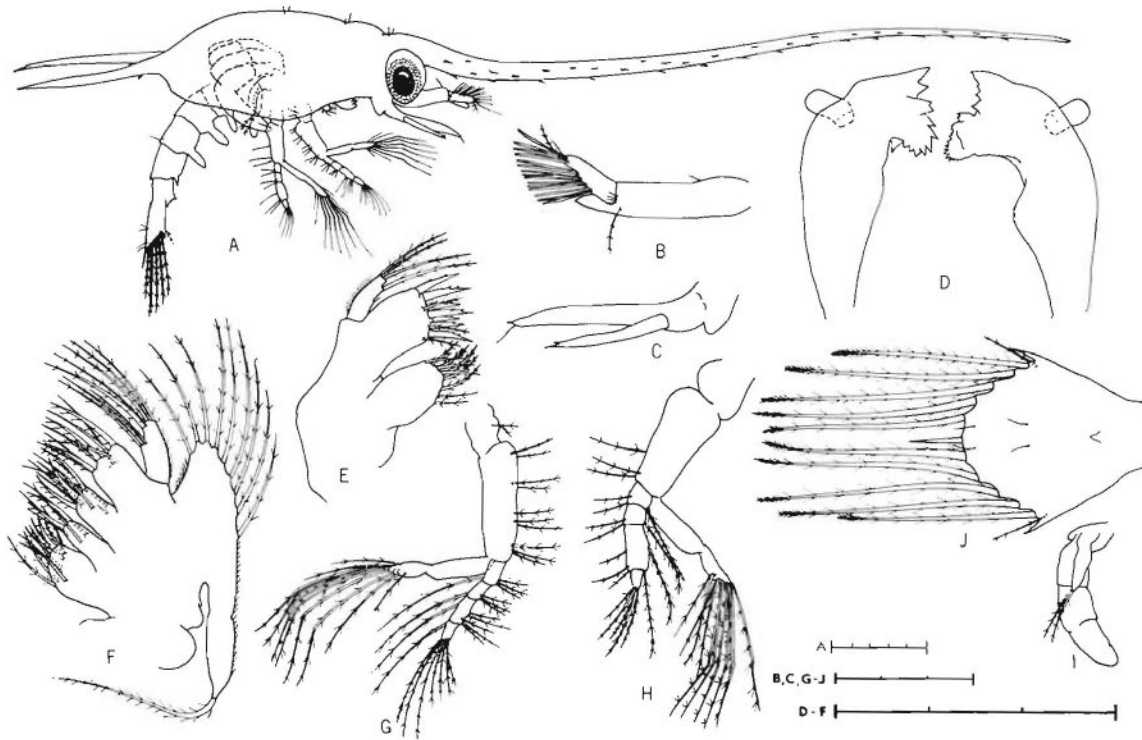


FIGURE 3. *Megalobrachium soriatum* (Say), second zoeal stage and appendages: A, second zoea; B, antennule; C, antenna; D, mandibles; E, maxillule; F, maxilla; G, maxilliped 1; H, maxilliped 2; I, maxilliped 3; J, telson. (Scale-lines equal 0.3 mm or 0.5 mm, according to divisions.)

Eyes cerulean blue with black eyespots, but appear more greenish in reflected light. Developing pereopod buds tinged with blue.

SECOND ZOEAE

Carapace Length.—1.2 mm.

Number of Specimens Examined.—Five.

Carapace (Fig. 3, A).—Carapace little larger than previous stage, retaining marginal serration, and dorsal setae. Rostral spine about $3 \times$ longer than carapace proper, less heavily armed than stage I; posterior carapace spines about $0.6 \times$ carapace length, armed with one small spine (rarely two). Eyes now mobile.

Antennule (Fig. 3, B).—Biramous; endopodite about $\frac{1}{2}$ length of exopodite, somewhat pointed but without setae. Exopodite with aesthetascs progressing distally as 2, 1, 3, 3, 2, plus four (as 3 + 1) terminally. Additional setae at exopodite tip, junction of exopodite with protopodite, and on basal medial projection of protopodite as illustrated.

Antenna (Fig. 3, C).—Exopodite reduced, now about $0.6 \times$ as long as endopodite, with a single subterminal spinule, often difficult to see. Endopodite retains single seta as illustrated.

Mandibles (Fig. 3, D).—Similar to stage I but with dentate and molar processes more developed. Palp present.

Maxillule (Fig. 3, E).—Endopodite unsegmented; now with four long setae, adding one subterminally; retaining short spinule. Basal endite with six or seven spines, three setae; coxal endite with four spines, six setae. Fine hairs as illustrated.

Maxilla (Fig. 3, F).—Endopodite unsegmented, setae as in stage I. Basal endite distal lobe, three spines, six setae; proximal lobe, three spines, five or six setae, a short spinule; coxal endite with two spines, four setae on distal lobe, ten processes (including six spinous setae subterminally) on proximal lobe. Scaphognathite with nine or ten setae around margin plus one apical seta as illustrated.

Maxilliped 1 (Fig. 3, G).—Coxopodite setae, 2; basipodite setae, 2, 2, 3, 3; endopodite setae, 3 + I, 3 + I, 2 + 3 + I, 7 + I; exopodite with 10 setae as illustrated.

Maxilliped 2 (Fig. 3, H).—Coxopodite naked; basipodite setae, 1, 2; endopodite setae, 2 + I, 2 + I, 1 + 2 + I, 5 + I; exopodite setae, 10.

Maxilliped 3 (Fig. 3, I).—Segmentation more or less distinct, increasing as stage progresses. Future exopodite shorter than endopodite, but with two long setae as illustrated.

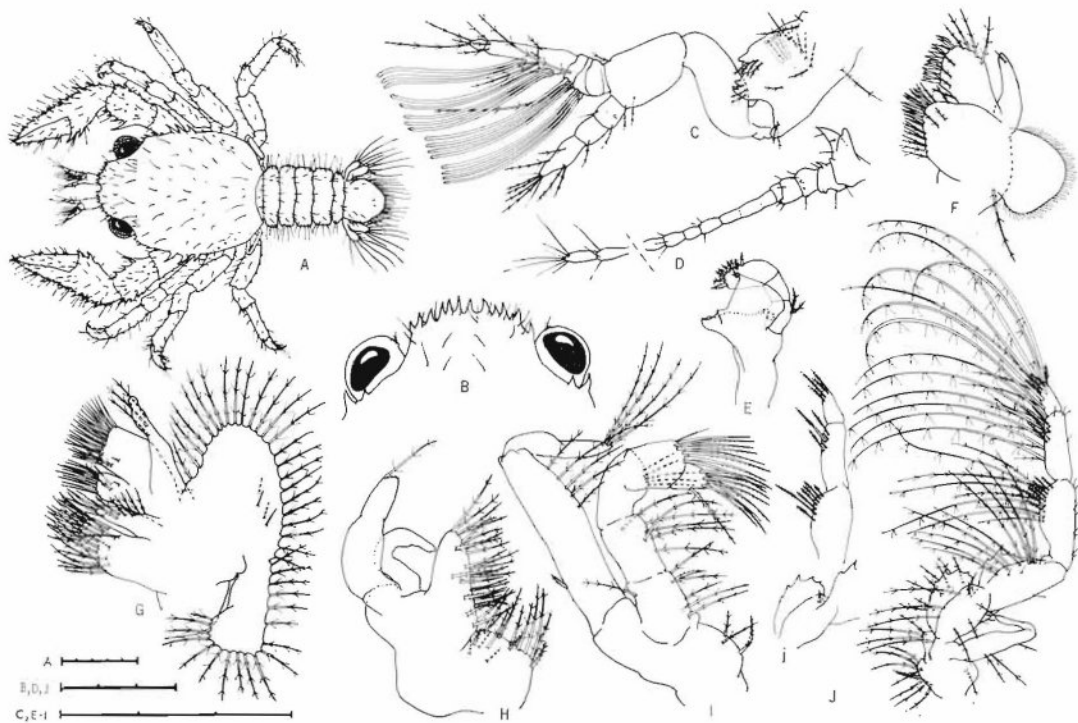


FIGURE 4. *Megalobrachium soriatum* (Say), megalopal stage and sensory and feeding appendages: A, megalopa; B, frontal region of megalopa; C, antennule; D, antenna; E, mandible; F, maxillule; G, maxilla; H, maxilliped 1; I, maxilliped 2; J, maxilliped 3; j, detail of spines on maxilliped 3. (Scale-lines equal 0.3 mm or 0.5 mm, according to divisions.)

Pereiopods (Fig. 3, A).—Continue to develop throughout stage, becoming much enlarged and assuming segmentation near end of stage. Much crowded and protruding from beneath carapace just before molt to megalopa.

Abdomen (Fig. 3, A).—Distinct lateral spine only on somite five; dorsal setae retained on somite four. Pleopods present only on somites 2, 3, 4, absent on 5. Pleopods elongate throughout stage.

Telson (Fig. 3, J).—Retaining fifth pair of plumose setae on central telsonal prominence but adding a single median spine here also. Other setae dorsally and ventrally, and serrations on long plumose setae tips as in stage I.

Color.—Rostral spine banded orange-white-orange-white progressing proximally from tip. A fifth yellowish band may sometimes be present. Other chromatophores and eye and pereiopod coloration as in stage I.

MEGALOPA

Carapace Length \times *Width*.— 1.0×0.8 mm.

Number of Specimens Examined.—Four.

Carapace (Fig. 4, A, B).—Longer than wide, subovate, inflated, convex from front to rear and side to side, becoming slightly more flattened posteriorly; frontal region much produced, extending beyond eyes and forming distinct shelf over antennules, a deep median depression present, anterior margin distinctly and heavily spinulose; epibranchial angle produced into series of short spinules, culminating in distinct spine at outer orbital angle followed immediately by shorter spine to interior (Fig. 4, B); lateral and subhepatic margins of carapace spiny, armature on lateral margin a series of small spines becoming progressively larger to about midlateral region of carapace, appearing as three or four very long curved spines, followed by several much-reduced spinules curving dorsiad onto posterolateral region of carapace. Entire carapace covered with long and short stiff hairs which trap detritus making spines difficult to see without cleaning. Eyes large, each with small group of granules antero-interiorly from which one or two thin hairs project. Megalopa shows little resemblance to adult at this stage.

Antennule (Fig. 4, C).—Biramous. Basal segment of three-segmented peduncle spinulose; lower ramus three segmented; upper ramus six or indistinctly seven segmented, but seventh segment incompletely divided and difficult to determine. Aesthetascs on a six-segmented ramus appear on segments two through five in the following sequence of rows and numbers: one row (4), one row (1 seta + 4 + 1 seta), two rows (3, 3, + 1 seta), one row (3). Other setae on both rami and peduncular segments as illustrated.

Antenna (Fig. 4, D).—Peduncle three-segmented, first movable segment drawn into large spinous process and more blunt process adjacently, other processes with spines and setae as illustrated. Flagellum with about nine to ten segments, inconsistent in same specimen on either side, with irregular setae around segments and terminal segment setae as illustrated.

Mandible (Fig. 4, E).—Scoop-shaped processes, dentate on lower margin, each with three-segmented palp. Basal segment with two, terminal segment with 10 or 11 short stiff spines.

Maxillule (Fig. 4, F).—Endopodite unsegmented, naked except for single subterminal seta; basal endite with 15 spines, eight setae; coxal endite with nine spines, 12 setae, endite extended into rounded hair-fringed lobe with single long seta near base, as illustrated.

Maxilla (Fig. 4, G).—Endopodite indistinctly two-segmented in some, one-segmented in others, three setae as shown, plus one small seta at base. Basal endite lobes with processes as follows: distal, about 24 plus short spinule, proximal, about 13, plus spinule; coxal endite distal lobe, five, plus seven laterally down side, proximal lobe, at least nine terminally, plus 14 or 15 in ring encircling lobe. Scaphognathite usually with 40-42 setae around margin plus additional setae on lateral surface as illustrated.

Maxilliped 1 (Fig. 4, H).—Exopodite with one seta and several short spinulelike projections terminally; endopodite appears naked, but extremely thin and nearly uncalcified so that setae may be easily lost; protopodite with about 26 setae on distal lobe, 15 (including short spinelike setae) on proximal lobe.

Maxilliped 2 (Fig. 4, I).—Exopodite two-segmented; five setae, one spine, on proximal segment, four setae, on distal segment. Endopodite five-segmented, setae progressing distally, six plus long spine, six, five, about nine spiny setae, about nine or ten spiny setae; a large recurved spine on basipodite.

Maxilliped 3 (Fig. 4, J, j).—Coxal lobe with small, hook-shaped protuberance, a large spine and about eight setae. Basal lobe with setae as shown. Major processes on five-segmented endopodite as follows: ischium, three long setae, one spine; merus, nine long setae; carpus, nine long setae plus seven daggerlike spines; propodus, six to eight long plumose setae plus five daggerlike spines; dactylus, seven to eight long plumose setae, four daggerlike spines. Ischium and merus with distinctly dentate platelike extensions, that on carpus much reduced and unarmed. Exopodite two-segmented, a single terminal seta on distal segment, three lateral setae on proximal segment. Figure 4, j shows detail of daggerlike spines and single spine on ischium.

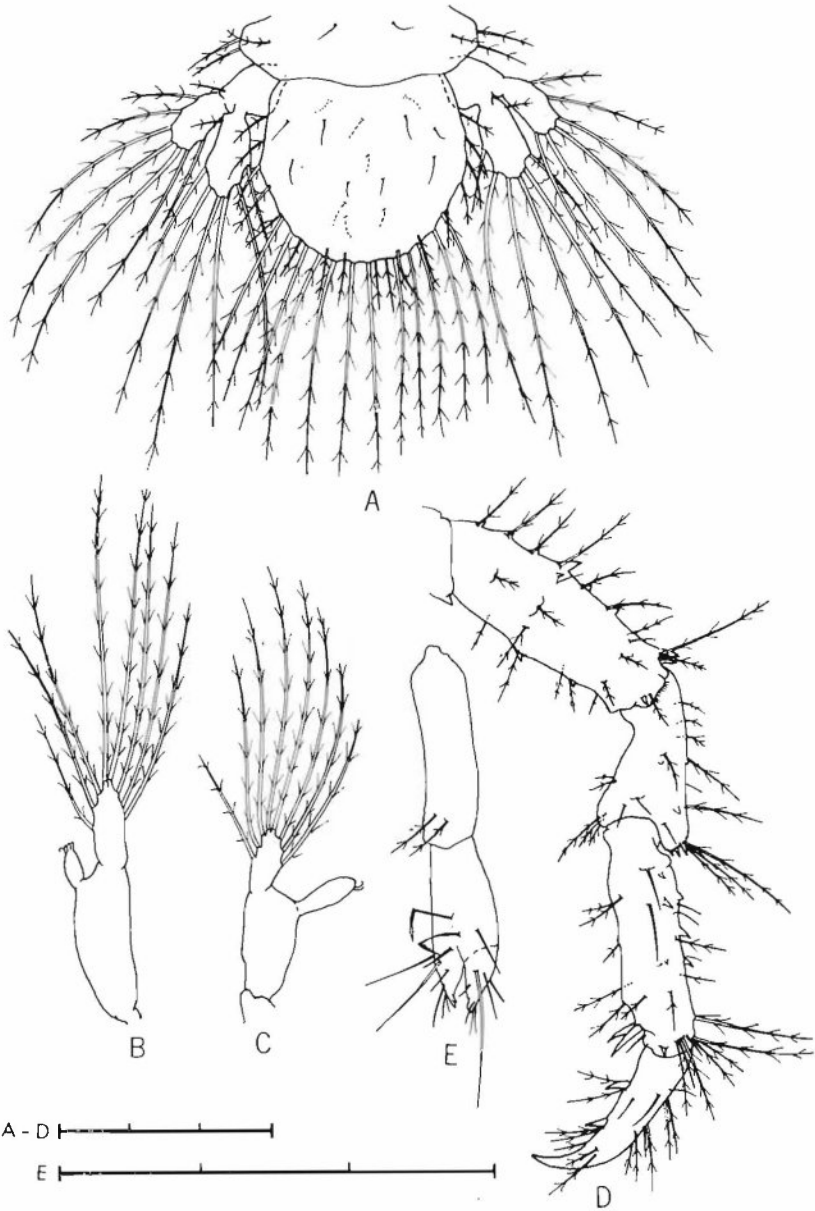


FIGURE 5. *Megalobrachium soriatum* (Say), megalopal locomotory appendages: A, telson; B, pleopod 1; C, pleopod 3; D, pereiopod 2; E, pereiopod 5. (Scale-lines equal 0.3 mm.)

TABLE 1
COMPARISON OF ZOEAL CHARACTERS IN THREE SPECIES OF *Megalobrachium*

| | <i>M. poeyi</i> | <i>M. pacificum</i> | <i>M. soriatum</i> |
|---------------|--|--|--|
| ZOEAL I | | | |
| ROSTRAL SPINE | Upswept | Upswept | Upswept |
| Length | 2.9 × carapace | 2.5 × carapace | 2.6 × carapace |
| Spination | 12-14 spinules | 5-7 spinules | Heavily armed |
| ANTENNA | | | |
| Exopodite | ¼ > endopodite 1 seta | Slightly > endopodite 1 seta | ¼ > endopodite 3 spinules |
| MAXILLULE | | | |
| Endopodite | 4, + 1 spinule | 4, + 1 spinule | 3, + 1 spinule |
| Basal endite | 6 spines, 3 setae | 6 spines, 3 setae | 5-6 spines, 3 seta |
| Coxal endite | 6 spines, 2 setae | 6 spines, 2 setae | 4 spines, 4 setae* |
| MAXILLA | | | |
| Endopodite | 5, 3, setae | 5, 3, setae | 5, 3, setae |
| Basal endite | 7-8 processes, proximal 7-8 processes, distal | 7-8 processes, proximal 7 processes, distal | 7 processes, proximal 7 processes, distal |
| Coxal endite | 7-8 processes, proximal 4-5 processes, distal | 7 processes, proximal 4-5 processes, distal | 7 processes, proximal 4-5 processes, distal |
| Scaphognath. | 6 setae | 6 setae | 6 setae |
| MAXILLIPED 1 | | | |
| Coxopodite | 2 setae | 2 setae | 2 setae |
| Basipodite | 2, 2, 3, 3, setae | 2, 2, 3, 3, setae | 2, 2, 3, 3, setae |
| Endopodite | 3, 3, 2 + 5, 9 + I | 3, 3, 2 + 5, 9 + I | 3, 3, 2 + 3, 7 + I |
| MAXILLIPED 2 | | | |
| Coxopodite | Naked | Naked | Naked |
| Basipodite | 1, 2, setae | 1, 2, setae | 1, 2, setae |
| Endopodite | 2, 2, 1 + 2, 5 + I | 2, 2, 1 + 2, 5 + I | 2, 2, 1 + 2, 5 + I |

* See text.

TABLE 1 (CONTINUED)

| | <i>M. poeyi</i> | <i>M. pacificum</i> | <i>M. soriatum</i> |
|---------------|--|---|---|
| ZOEA II | | | |
| ROSTRAL SPINE | Upswept | Upswept | Upswept |
| Length | 3.5 × carapace | 1.7 × carapace | 3 × carapace |
| Spination | 18 spinules | 4-7 spinules | Less heavily armed than Zoea I |
| ANTENNULE | | | |
| Exopodite | 3, 3, 3, 3, 2, + 4 aesthetascs | 3, 3, 3, 3, 2, + 4 aesthetascs | 2, 1, 3, 3, 2, + 4 aesthetascs |
| Protopodite | No long distal seta | No long distal seta | 1 long distal seta |
| ANTENNA | | | |
| Exopodite | ½ length endopodite 1 seta | ½ length endopodite 1 seta | 0.6 length endopodite 1 spinule |
| MANDIBLES | Palp present | Palp present | Palp present |
| MAXILLULE | | | |
| Endopodite | 4 setae, 1 spinule | 4 setae, 1 spinule | 4 setae, 1 spinule |
| Basal endite | 7 spines, 3 setae | 7 spines, 3 setae | 7 spines, 3 setae |
| Coxal endite | 6 spines, 4 setae | 6 spines, 4 setae | 6 spines, 4 setae |
| MAXILLA | | | |
| Endopodite | 5, 3, setae | 5, 3, setae | 5, 3, setae |
| Basal endite | 10 processes, proximal 10 processes, distal | 8 processes, proximal 10 processes, distal | 9 processes, proximal 9 processes, distal |
| Coxal endite | 10 processes, proximal 6 processes, distal | 10 processes, proximal 6 processes, distal | 10 processes, proximal 6 processes, distal |
| Scaphognath. | 20 setae | 19 setae | 10 setae |
| MAXILLIPED 1 | | | |
| Endopodite | 3 + I, 3 + I, 2 + 5 + I, 9 + I setae | Same as <i>M. poeyi</i> | 3 + I, 3 + I, 2 + 3 + I, 7 + I setae |
| MAXILLIPED 2 | 2 + I, 2 + I, 1 + 2 + I, 5 + I setae | Same as <i>M. poeyi</i> | 2 + I, 2 + I, 1 + 2 + I, 5 + I setae |
| MAXILLIPED 3 | 4 setae | 4 setae | 2 setae |
| ABDOMEN | | | |
| Pleopods | Somites 2, 3, 4, 5 | Somites 2, 3, 4, 5 | Somites 2, 3, 4 |

Pereiopods (Figs. 4, A; 5, D, E).—Chelipeds large, somewhat flattened, subequal, heavily spinose and covered with long and short setae. Carpus with at least four large spines of decreasing size distally on anterior margin, plus additional short blunt spines on dorsal surface and longer curved spines on posterior margin. Manus distinctly and heavily spined on inner and outer margins, and upper margin of movable finger. Walking legs also noticeably spinose, especially on dorsal margin of merus, distal margin of carpus and dorsal and dorsolateral margin of propodus. Additional spines appear ventrally on these segments as illustrated. Pereiopod 5 chelate, gape dentate only at tip, with long setae and scythelike setae as illustrated.

Pleopods (Fig. 5, B, C).—Present only on somites 2, 3, 4, absent on somite 5 as in previous stage, biramous, decreasing in size toward telson. Exopodal setae inconsistent in same specimen, progressing toward telson as 8-9, 9-10, 8 or 9, highest number appears on middle pleopod pair, most consistent number on pair nearest telson. Endopodites naked, but with hooks developed as appendix interna.

Abdomen (Fig. 4, A).—Pleura as illustrated, covered with many short and long setae.

Tail Fan (Fig. 5, A).—Telson usually with 6 + 6 long plumose setae plus additional shorter processes interspersed among these. Uropodal setae inconsistent in same specimen; exopodite usually with six or seven long setae, endopodite with six setae. Other shorter setae on tail fan as illustrated.

Color.—Megalopa nearly transparent but often covered with detritus caught in long setae. Red chromatophores appear as follows: on dorsal surface of carpus and manus of chelipeds, on carpus-propodus articulation of first walking leg, on mandible, and bases of maxillipeds 1 and 2. Eyes have lost their blue color, appearing now almost black or very dark bluish black. In some specimens very small red chromatophores appear ventrally on the coxopodites of the pereiopods.

DISCUSSION

The zoeal stages of *Megalobrachium soriatum* should not be difficult to recognize in the western Atlantic plankton. The upswept or "skewed sigmoid" shape of the rostral spine, the almost complete lack of spinules (except for one or two) on the posterior carapace spine, the distal spinulation on the antennal exopodite, the paired dorsal setae on the fourth abdominal somite, the serrated ventral margin of the carapace, and the lack of strong hooklike spinules on the elongate plumose setae of the telson are all features which may aid in identifying these larvae. In live specimens the orange-white-orange banding distally on the tip of the rostral spine may also be definitive for the species.

The megalopal stage is also quite distinctive, since it is the only one presently known from the western Atlantic which is so noticeably spiny, both on the carapace, and on the chelipeds and walking legs. However, both the second zoeal and the megalopal stage have features which are found in the respective stages of another genus and these will be discussed below.

Larvae are known for two other species of *Megalobrachium*: *M. poeyi* from the western Atlantic, and *M. pacificum*, a new eastern Pacific species formerly considered conspecific with *M. poeyi* (see Gore, 1971; Gore & Abele, 1973). A comparison of salient features in the larvae of all three species is presented in Table 1. It is evident that the larvae of *M. soriatum* agree in several respects with those of *M. poeyi* and *M. pacificum*, especially in rostral spine curvature, length of the antennal exopodite, the subterminal setule on the maxillulary endopodite (and to a lesser extent, the other setation on the maxillule), the setation on the maxilla, on the basipodites and coxopodite of maxilliped 1, and the elongate plumose setae on the telson. The most notable differences occur in the armature of the rostral spine, the number of aesthetases on the antennule exopodite in stage II, the setation on the maxillary sephognathite in this stage, the differences in number of setae on the endopodite of maxilliped 1 in both stages, and, most unusually, the presence of only three pairs of pleopod buds in the second zoea. This latter feature is remarkable and will be discussed at length later.

The megalopae of all three species are spiny to a greater or lesser extent, with that of *M. soriatum* being the most distinctive in this respect. Further points of agreement (Table 2) are seen in the setae on the maxillulary and maxillary endopodites, the single long seta near the base of the coxal endite of the maxillule, the spinous basal peduncular segment of the antennule, the exopodite of maxilliped 2, and the dentate ischial, meral and carpal plates on maxilliped 3. Easily seen differences occur in the number of aesthetases on the antennule, the antennal flagellum segments, maxillary sephognathite setae, and in the position and number of processes on maxilliped 3, pleopods and tail fan (see also, Gore, 1971: 422). Again, only three pairs of pleopods are present, whereas in the other two species of *Megalobrachium* four pairs are invariably found.

The presence of the fifth pair of plumose setae on the central prominence of the telson in stage I, and the addition of a median spine in this position in stage II shows that the larvae of *M. soriatum*, like those of its congeners, belong to the *Petrolisthes*-group of larvae. The presence of a mandibular palp in stage II provides additional support, since nearly all larvae in the *Petrolisthes*-group have this feature in the second stage. In addition, larvae of *M. soriatum* agree with other known larvae of *Megalobrachium* in lacking the distinct hooklike spinules on the distal tips of the elongate plumose

TABLE 2
COMPARISON OF MEGALOPAL CHARACTERS IN THREE SPECIES OF *Megalobrachium*

| | <i>M. poeyi</i> | <i>M. pacificum</i> | <i>M. soriatum</i> |
|-------------------|---------------------------------------|--|---------------------------------------|
| CARAPACE | | | |
| Length × width | 1.3 × 1.4 mm | 1.1 × 1.2 mm | 1.0 × 0.8 mm |
| Frontal region | 20-24 spines | Unarmed | More distinctly and heavily spinulose |
| Lateral margin | Prominent denticles | Small widespread denticles | Large distinct spines |
| ANTENNULE | | | |
| Aesthetasc number | (6) (3, 3) (3, 2) (3)* | (5) (3, 3) (3, 2) (3)* | (4) (4) (3, 3) (3) |
| ANTENNAL FLAGELLA | | | |
| | 23-24 segments | 18-21 segments | 9-10 segments |
| MANDIBULAR PALP | | | |
| | 14-15 spines | About 11 spines | 10-11 spines |
| MAXILLULE | | | |
| Endopodite | 1 subterminal seta | 1 subterminal seta | 1 subterminal seta |
| Basal endite | 17 spines, 10 setae | 13 spines, 8-9 setae | 15 spines, 8 setae |
| Coxal endite | 25 processes 1 long seta near base | 18-20 processes 1 long seta near base | 21 processes 1 long seta near base |
| MAXILLA | | | |
| Endopodite | 3 setae | 3 setae | 3 setae |
| Scaphognathite | 56-63 setae | 49-50 setae | 40-42 setae |
| Coxal endite | 16 encircling lobe | 14 encircling lobe | 14-15 encircling lobe |
| MAXILLIPED 1 | | | |
| Exopodite | 5 setae | 5-6 setae | 1 seta |
| Endopodite | 1-2 setae | 2 setae | Probably none |

* Formula erroneously indicated by Gore (1971: 422, Table 3).

TABLE 2 (CONTINUED)

| | <i>M. poeyi</i> | <i>M. pacificum</i> | <i>M. soriatum</i> |
|--------------|--|--------------------------------|--------------------------------------|
| MAXILLIPED 2 | | | |
| Exopodite | 5 terminal; 5, 1 lateral setae | 4 terminal; 6, 3 lateral setae | 4 terminal; 5 lateral setae, 1 spine |
| MAXILLIPED 3 | Ischial, meral, and carpal plates on endopodite distinctly dentate in all species. | | |
| ABDOMEN | Pleopods on somites 2, 3, 4, 5 | Same as <i>M. poeyi</i> | Pleopods on somites 2, 3, 4 |
| TAIL FAN | | | |
| Telson | 8 + 8 long setae | 8 + 8 long setae | 6 + 6 long setae |
| Uropodites | | | |
| Exopodites | 11-15 setae | 13 setae | 6-7 setae |
| Endopodites | 10-12 setae | 8-10 setae | 6 setae |

telson setae. These spinules, however, are present in *Pachycheles* and *Petrolisthes* larvae, the other members of the *Petrolisthes*-group.

Both the second zoeal and the megalopal stages of *M. soriatum*, however, are unusual among members of the genus *Megalobrachium* and, indeed, other known *Petrolisthes*-group larvae by having but three pairs of pleopods on the abdomen. Until now, this feature had been found only in the second zoeae and megalopae of some species of *Pisidia*, a member of the *Porcellana*-group of larvae (e.g., Sars, 1889; Lebour, 1943; Bourdillon-Casanova, 1956). Zoeae of *Megalobrachium soriatum* also resemble larvae of *Pisidia* (where adequate descriptions of such larvae exist) in the single or double enlarged ventral spinules near the insertion of the posterior carapace spines, in the spination on the antennal exopodites, and in the pair of fine setae just off the central prominence of the telson. The megalopae of *M. soriatum* also have a close resemblance to those known from *Pisidia* in the lateral armature of the carapace (e.g., Menon, 1940; and authors previously cited). This last character is diagnostic (among others) for adults of the genus *Pisidia*, but not *Megalobrachium*. In the latter genus only *M. soriatum* and its eastern Pacific geminate, *M. tuberculipes*, have the lateral margins of the carapace dentate. Interestingly, both species also belong to a small group in *Megalobrachium* which has five-plated instead of seven-plated telsons (*M. poeyi* and *M. pacificum* have seven telson plates, as does *Pisidia*).

A comparison of the diagnoses for adults of *Pisidia* and *Megalobrachium* by Haig (1960) shows that, although both genera share some diagnostic features, they are, nevertheless, distinct. *Pisidia*, for example, is characterized by having the fingers of one or both chelipeds twisted out of plane with the manus, and by having the basal antennal segment strongly produced inward, forming a partial suborbital margin. In *Megalobrachium* the fingers of the chelipeds are never bent out of plane, and the basal antennal segment is truncate and not produced into a partial suborbital margin. The megalopal stage of *M. soriatum* exhibits both of these adult characters of the genus, although it is evident that, in some other respects, the megalopa itself bears little resemblance to the adult (the latter characteristic is shared by megalopae of other species of *Megalobrachium*; Gore, 1971). It should also be remembered that larvae of *Pisidia*, belonging as they do to the *Porcellana*-group of larvae, share that grouping's characteristics; namely, the presence of the fifth pair of plumose setae off (not on) the central prominence of the telson, the addition of a sixth pair of setae in this position in stage II (instead of a median spine), and the lack of a mandibular palp in the second zoeal stage.

The several features exhibited by the second stage zoeae and megalopae of *M. soriatum*, and their similarity to such features occurring in the larvae of *Pisidia*, are certainly intriguing. Further study of larval characters such

as these may point the way toward a better understanding of relationships between the adults of the two genera.

SUMARIO

ESTUDIOS DE CRUSTÁCEOS DECAPODOS DE LA REGIÓN DEL INDIAN RIVER DE LA FLORIDA. II. *Megalobrachium soriatum* (SAY, 1818): DESARROLLO LARVAL EN CULTIVO DE LABORATORIO (CRUSTACEA: DECAPODA; PORCELLANIDAE)

El desarrollo larval del cangrejo porcelánido *Megalobrachium soriatum* (Say, 1818), una de las tres especies del género que se presenta en el Atlántico occidental, es completamente descrito e ilustrado. Como en la mayoría de los otros cangrejos porcelánidos, hay una prezoa de corta duración, dos estados de zoca (cada uno con 6 días de duración aproximadamente) y un estado de megalopa. El último estado dura hasta 8 días, pero como no se obtuvieron estados de cangrejo 1, la duración exacta de este estado no se conoce. Las larvas y megalopas de *M. soriatum* comparten muchos caracteres con las de *M. poeyi* del Atlántico y *M. pacificum* del Pacífico oriental. Sin embargo, los segundos estados de zoea y megalopa de *M. soriatum* también presentan caracteres que son observados en algunas segundas zoeas y megalopas de especies de *Pisidia*. Estos caracteres incluyen la presencia de sólo tres, en lugar de cuatro, pares de pleópodos en los estados respectivos y la ocurrencia de una serie de espinas largas en el margen lateral del carapacho en el estado de megalopa. Esta situación es extraordinaria ya que las larvas de *Megalobrachium* y *Pisidia* están asignadas a dos diferentes grupos de larvas; la primera pertenece al grupo *Petrolisthes*, mientras que la última pertenece al grupo *Porcellana*. Estudios ulteriores sobre las larvas de los dos géneros podrán aclarar las relaciones compartidas por los respectivos adultos.

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