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# LABORATORY CULTURED ZOEAE, MEGALOPA AND FIRST CRAB OF THE ESTUARINE CRAB *THALAMITA CRENATA* (LATR.) A . MILNE EDWARDS 1861 (BRACHYURA : PORTUNIDAE)

T. KRISHNAN AND T. KANNUPANDI
Marine Ecology and Coastal Aquaculture Unit
Centre of Advanced Study in Marine Biology
Annamalai University, Parangipettai - 600 502, Tamil Nadu.

## ABSTRACT

Larvae of *Thalamita crenata* (Latr.) A. Milne Edwards, 1861 were reared in the laboratory to the first crab instar under the rearing conditions of salinity 30 ± 1‰, temperature 27 ± 1°C and photophase 12/12 h light/dark. First zoea reached first crab instar after six moults with a minimum time of 25 days. Five zoeal, megalopal and first crab instar are figured and described. Zoeae, megalopa and first crab are compared with other known descriptions on *Thalamita* spp. Possible reasons for variation in the number of zoeal stages are discussed.

*Key-words* : *Thalamita crenata*, zoeae, megalopa, first crab instar, Brachyuran larvae, larval development.

## INTRODUCTION

As far as the larval development of *Thalamita* spp. is concerned, first zoeal descriptions are known for *T. crenata* (hatched in the laboratory - Prasad and Tampi, 1953; from plankton - Chhapgar, 1956) , *T. poissonii* (Al-Kholy, 1963) , *T. prymna* (Kurata, 1975) and *T. admete* (laboratory hatched Greenwood and Fielder, 1979). Previous works on complete larval development based on laboratory culture studies indicates that there are intra and inter-specific variations in the number of zoeal stages in same and different waters – *T. sima* has 5 zoeal stages (Kurata, 1975) in Japan waters, while 6 zoeal stages (Greenwood and Fielder, 1979; Terada, 1979) from Australian and Japan waters respectively, *T. danae*, 3 zoeal stages (Fielder and Greenwood, 1979; Greenwood and Fielder, 1979) while 5 zoeal stages (Krishnan and Kannupandi, 1988) from Indian waters and *T. crenata*, 7 zoeal stages (Greenwood and Fielder, 1979) from Australian waters, while 3 zoeal stages (Thomas, Khan, Kannupandi and Natarajan, 1980) in Indian waters. This paper reports the 5 zoeal stages, megalopa and first crab instar of *T. crenata*.

## MATERIAL AND METHODS

Ovigerous females of *T. crenata* were collected from the Vellar estuary by cast net and maintained individually in the laboratory, in plastic troughs containing

estuarine water of salinity 30 ± 1‰ and temperature 27 ± 1°C. Hatching of eggs lasted over 30 minutes in the early hours. Newly hatched first zoeae were separated into groups of 10 per glass bowl (55 mm diam. x 50 mm depth) containing aerated filtered estuarine water of salinity 30 ± 1 and fed with freshly hatched Brazilian strain of *Artemia* nauplii. Laboratory culture conditions of salinity 30 ± 1‰ temperature 27 ± 1°C and photophase 12/12 h light/dark were maintained. The larvae were examined each day before changing water for the presence of live, dead larvae and exuviae. Samples of each larval stage and exuviae were preserved in 10% neutral formalin for observation and illustration. Drawings were made with the aid of camera lucida and measurements were taken with micrometer eye piece.

## RESULTS AND DISCUSSION

Five zoeal stages appeared during the larval development of *T. crenata* under laboratory culture conditions. Each zoeal stage required a minimum time of 3 days to moult to next stage except the fifth zoea, which took 5 days to metamorphose to megalopa. First crab appeared after 8 days from megalopa thus a minimum period of 25 days was required for completing metamorphosis.

### *Description of developmental stages*

The first zoeal stage is described in full detail and only changes in morphology and setation are described for the subsequent zoeal stages. In all descriptions, setal formulae progress distally. In each stage 25 specimens were examined.

The abbreviations used are : A1 - antennule; A2-antenna; Md- mandible; Max 1-maxillule; Max 2-maxilla; Mxp 1 to 3-maxillipeds 1-3; P 1 to 5-pereiopods 1-5; pl 1 to 4-pleopods 1-4; Ab-abdomen; T-telson and U-uropod.

*First zoea* (Fig.1)

Carapace length 0.40 mm; dorsal spine length 0. 32 mm; rostral spine length 0.27 mm; lateral spine length 0.07 mm; abdomen length 0.80 mm.

Carapace (Fig. 1A) : Smooth, globose, with dorsal, rostral and lateral spines. Posterolateral margin without any setae. Paired simple setae between eyes, posterolaterally to base of dorsal spine in all zoeal stages. Eyes sessile. Ab (Fig. 1B) : Five somites, first naked, second and third with paired lateral knobs (third smaller) directed as in Fig. 1; second through fifth somites with postero-lateral spines. Pair of posterodorsal simple setae on somites 2-5 in all zoeal stages. T (Fig. 1B) : Broadly forked, furca covered with denticles. Posterior margin with 3 pairs of setae distally serrated, each furca has 2 lateral simple setae. A1 (Fig. 1C) : Smooth, conical, with 3 terminal aesthetascs . A2 ( Fig. 1D) : Protopod armed with 2 rows of spinules . Exopod

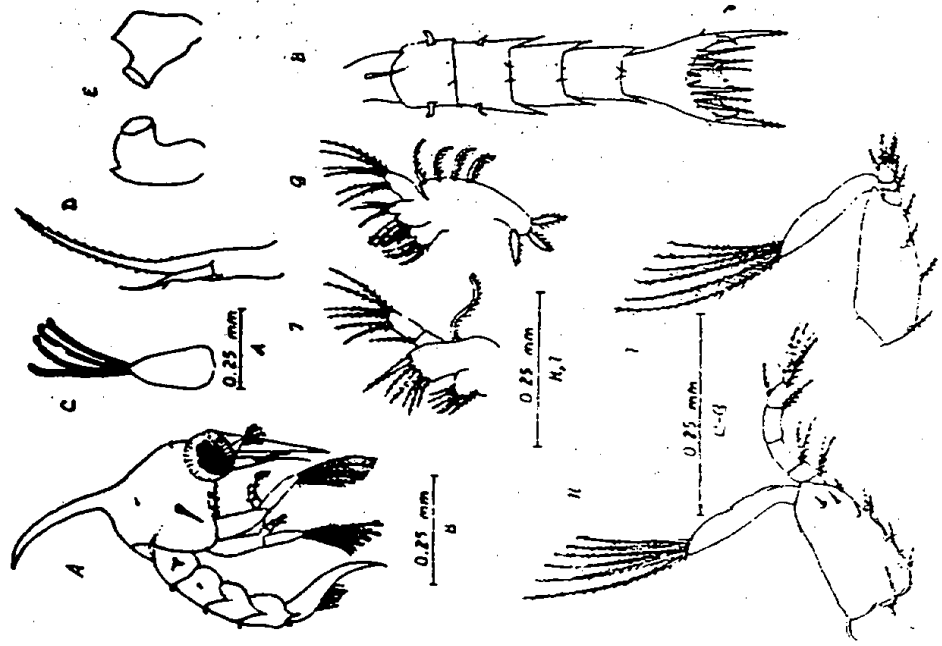


Fig. 2. Second zoea of *Thalamita crenata*. A, Lateral view; B, Abdomen and telson; C, Antennule; D, Antenna; E, Mandible; F, Maxillule; G, Maxilla; H, Maxilliped 1 & I, Maxilliped 2.

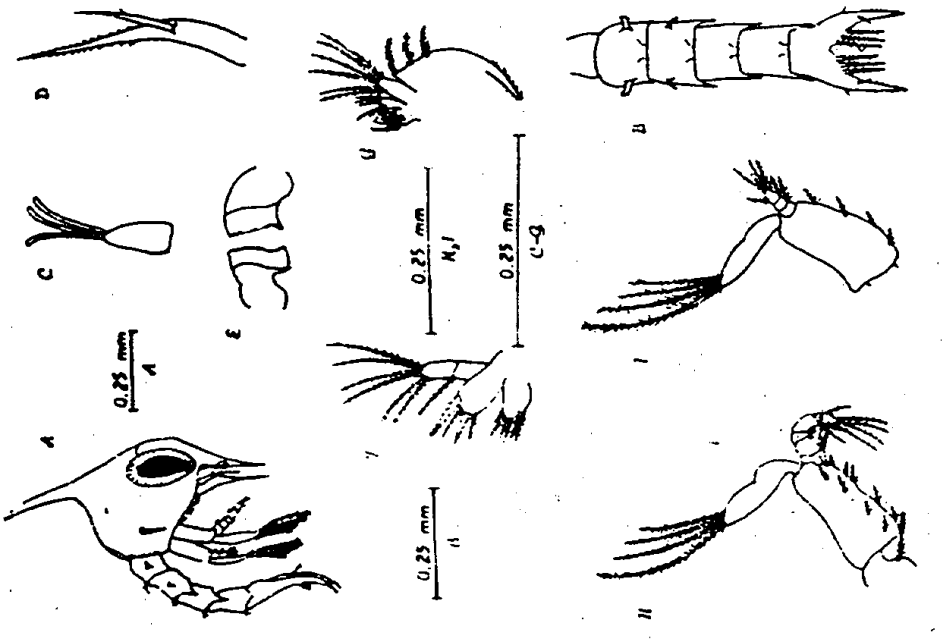


Fig. 1. First zoea of *Thalamita crenata*. A, Lateral view; B, Abdomen and telson; C, Antennule; D. Antenna, E. Mandible; F, Maxillule; G, Maxilla; H, Maxilliped 1 & I, Maxilliped 2.

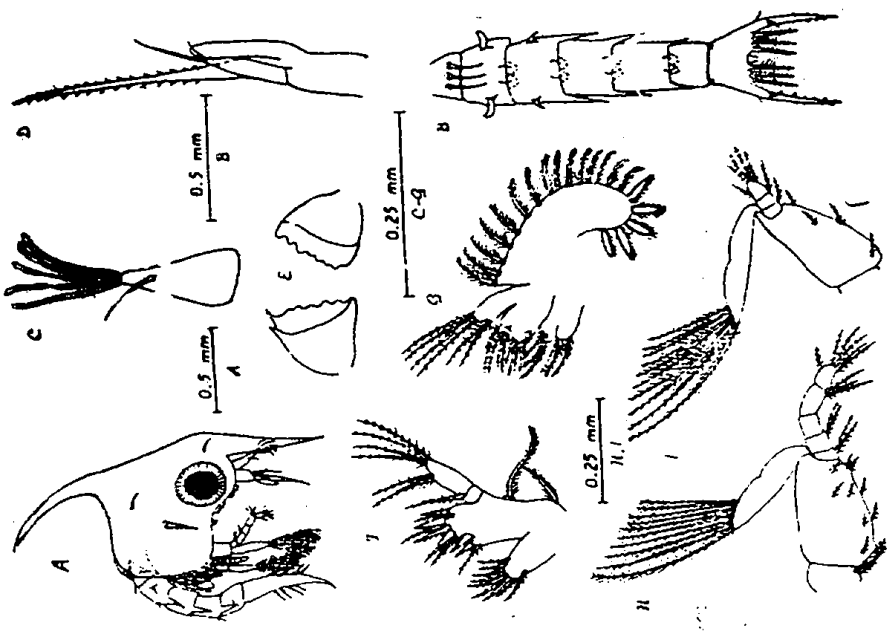


Fig. 4. Fourth zoea of *Thalamita crenata*. A, Lateral view; B, Abdomen and telson; C, Antennule; D, Antenna; E, Mandible; F,Maxillule; G, Maxilla; H, Maxilliped 1 & I, Maxilliped 2.

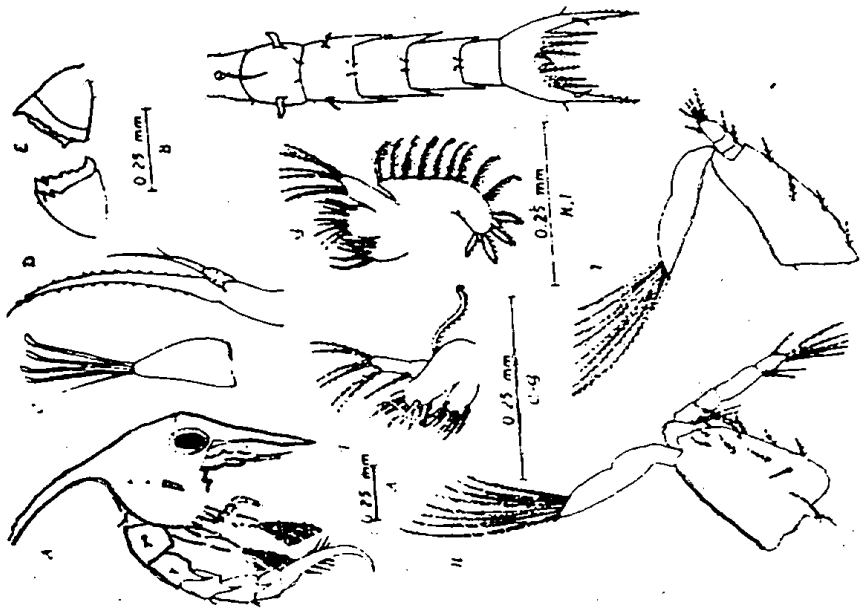


Fig. 3. Third zoea of *Thalamita crenata*. A, Lateral view; B, Abdomen and telson; C, Antennule; D, Antenna; E, Mandible; F, Maxillule; G. Maxilla; H, Maxilliped 1 & I, Maxilliped 2.

short pointed about one-half length of protopod, with a simple seta at one-third distance from base. Md ( Fig. 1E) : Asymmetrical left mandible with irregular denticulation. Max 1 (Fig. 1F) : Coxal endite with 6 setae. Basal endite with 4 setae. Endopod 2-segmented, setal formula 1.6 (4 terminal + 2 subterminal). Max 2 (Fig. 1G) : Coxal endite bilobed, with 3,2 plumose setae. Basal endite bilobed, setal formula 3,3 setae. Endopod with 6 setae (4 terminal + 2 subterminal). Scaphognathite with 3 plumose setae on outer margin, pointed terminal process with fine hairs. Mxp. 1 (Fig. 1H) : Coxa with 1 plumose seta. Basis with 2,2,3,3 setae. Endopod 5-segmented, setal formula 2,2,0,2,4+1. Exopod partially 2-segmented. with 4 terminal plumose natatory setae. Mxp 2 (Fig. 1I) : Coxa naked. Basis with 4 seate as 1,1,1,1. Endopod 3-segmented, setal formula 1,1,5 setae in all zoeal stages. Exopod indistinctly 2-segmented, with 4 plumose natatory setae.

Colour : Larva yellowish-brown in general colouration. Yellow and reticulate reddish chromatophores on carapace. Eyes black coloured. This pattern continues in all subsequent zoeal stages.

*Second zoea* (Fig.2)

Carapace length 0.50 mm; dorsal spine length 0.39 mm; rostral spine length 0.39 mm; lateral spine length 0.09 mm; abdomen length 1.06 mm.

Carapace (Fig.2A) : Similar to first stage, posterolateral margin still without any setae. Eyes stalked. Ab(Fig.2B): Five somites; first somite with 1 long dorsal simple seta. T (Fig. 2B): Now telson formula with 4+4 setae, innermost pair shortest. A1 (Fig. 2C) : With 4 equal aesthetascs. A2 (Fig. 2D) : Similar to first stage. Md (Fig.2E) : Left incisor with 1 pointed tooth, molar margins irregularly dentate. Max 1 (Fig. 2F) 1 Basal endite with 6 setae plus 1 long plumose seta on basal margin. Max 2 (Fig. 2G) : Basal endite with setation 4,3. Scaphognathite with 4 long thin plumose setae proximally, 3 stout plumose setae distally. Mxp 1 and 2 (Figs. 2H,I) : Exopod now with 6 plumose natatory setae.

*Third zoea* (Fig. 3)

Carapace length 0.63 mm; dorsal spine length 0.51 mm; rostral spine length 0.49 mm; lateral spine length 0.10 mm: abdomen length 1.34 mm.

Carapace (Fig. 3A) : Posterolateral margin with 4 plumose setae. Ab (Fig. 3B) : Six somites. T (Fig. 3 B) : As in the second zoea. A1 (Fig. 3C) : With 4 aesthetascs plus 1 simple seta. A2 (Fig. 3D) : Endopodal bud now developed. Md (Fig. 3E) : Left incisor with 6 teeth, right with 1 prominent tooth. Left molar irregularly dentate. right molar with 1 pointed tooth with irregular small teeth. Max 1 (Fig. 3F) : Coxal endite with 7 and basal with 8 setae, outer seta continued. Max 2 (Fig. 3G) : Coxal endite with 6 and

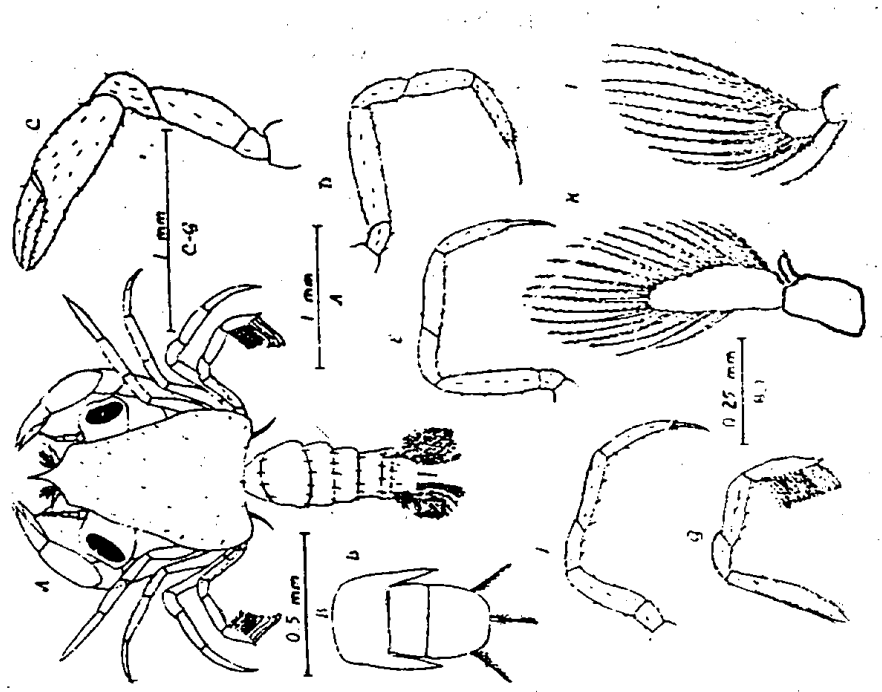


Fig. 6. Megalopa of *Thalamita crenata*. A, Dorsal view; B, Telson; C, First pereiopod; D, Second pereiopod; E, Third pereiopod; F, Fourth pereiopod; G, Fifth pereiopod; H, First pleopod & I, Uropod.

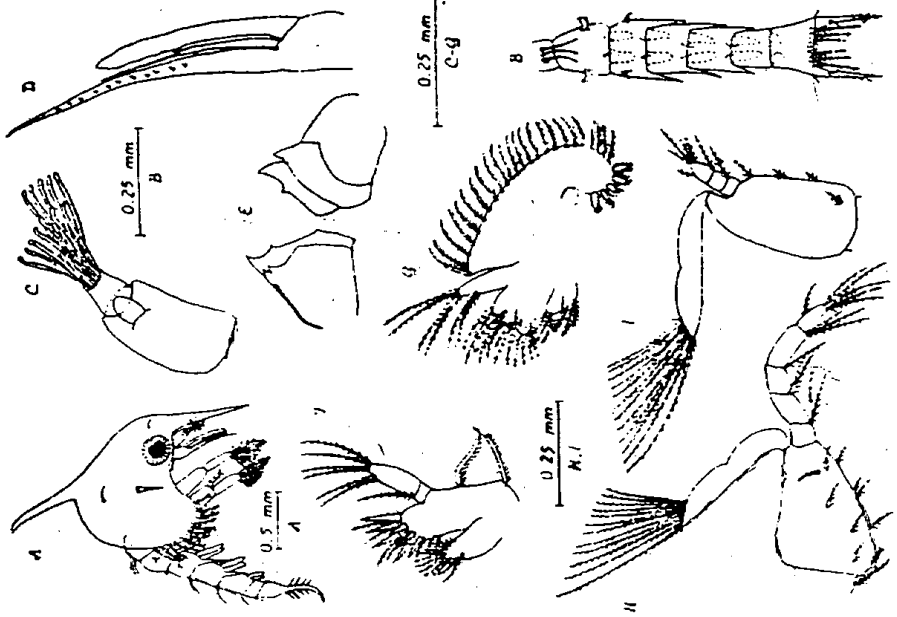


Fig. 5. Fifth zoea of *Thalamita crenata*. A, Lateral view; B, Abdomen and telson; C, Antennule; D, Antenna; E, Mandible; F, Maxillule; G, Maxilla; H, Maxilliped 1 & I, Maxilliped 2.

basal endite with 9 setae. Scaphognathite setae increased to 9 marginal plus 4 stout distal plumose setae. Mxp 1 (Fig. 3H) : Endopod with setal formula 2,2,0,2,5+1 setae. Exopod of the both maxillipeds with 8 plumose natatory setae.

*Fourth zoea* (Fig. 4)

Carapace length 0.79 mm; dorsal spine length 0.66 mm; rostral spine length 0.63 mm; lateral spine length 0.11 mm; abdomen length 1.63 mm.

Carapace (Fig. 4A) : Posterolateral margin with 7 plumose setae. Ab (Fig. 4B) : Six somites, first somite now with 3 long middorsal simple setae instead of 1. Pl 1-4 and U: Pleopod and uropod buds now present on somites 2-5 and 6, respectively. T (Fig. 4B): As in the third zoea. A1 (Fig. 4C): With 5 equal terminal aesthetascs plus 1 simple seta. A2 (Fig. 4D) : Endopod bud now present one-third length of protopod. Md (Fig. 4E) : Left incisor margin with 2 large teeth. Right incisor with 3 bluntly rounded teeth. Molar margins with small teeth. Max 1 (Fig. 4F) : Coxal endite with 9 setae, basal with 11 setae, 2 plumose outer setae instead of 1. Max 2 (Fig. 4G): Basal endite with 5,5 setae. Scaphognathite with 15 plumose setae all over margin and 5 stout plumose setae on distally. Mxp 1 (Fig. 4H) : Coxa now with 2 plumose ventral setae. Endopod with setal formula 2,2,0,3,5+1 setae. Exopod with 10 plumose natatory setae in both Max 1&2. Mxp 3: As uniramous bud. P 1-5: uniramous buds.

*Fifth zoea* (Fig. 5)

Carapace length 1.06 mm; dorsal spine length 0.87 mm; rostral spine length 0.78 mm; lateral spine length 0.12 mm; abdomen length 2.26 mm.

Carapace (Fig. 5A) : Posterolateral margin with 12 plumose seate. Ab (Fig. 5B) : Six somites. Pl 1-4 and U: Pleopod and uropod buds elongate. T (Fig. 5B) : process formula 4+1+4 setae. A1 (Fig. 5C) : Biramous, inner ramous as bud, 2 tiers of aesthetascs, 5 terminal and 7 subterminal on outer ramus. A2 (Fig. 5D): Endopod bud elongated two-third length of protopod process. Md (Fig. 5E) : Left incisor with 4 teeth, right with 3 teeth. Left molar with 1 tooth. Max 1 (Fig. 5F) : Coxal and basal setae increased to 11 and 14. Max 2 (Fig. 5G) : Coxal endite with 4,3 and basal with 7,6 setae. Scaphognathite with 24 thinner plumose setae plus 6 stouter distal plumose setae. Mxp 1 (Fig. 5H) : Endopod with 2,2,1,3,5+1 setae. Exopod of both first and second max. with 12 plumose natatory setae. Mxp 3 : Biramous bud. P 1-5 : Elongated buds.

*Megalopa* (Figs. 6,7)

Carapace length (including rostrum) 1.68 mm; carapace width 1.26 mm; rostrum length 0.44 mm; abdomen length 1.37 mm.

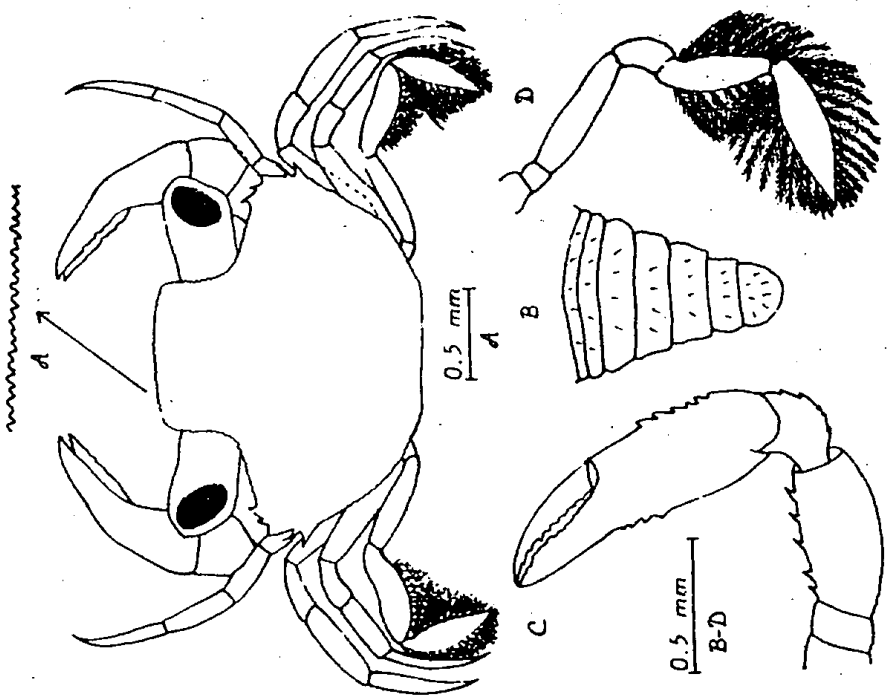


Fig. 8. First instar of *Thalamita crenata*. A, Dorsal view; B, Abdomen and telson; C. First pereiopod & D, Fifth pereiopod.

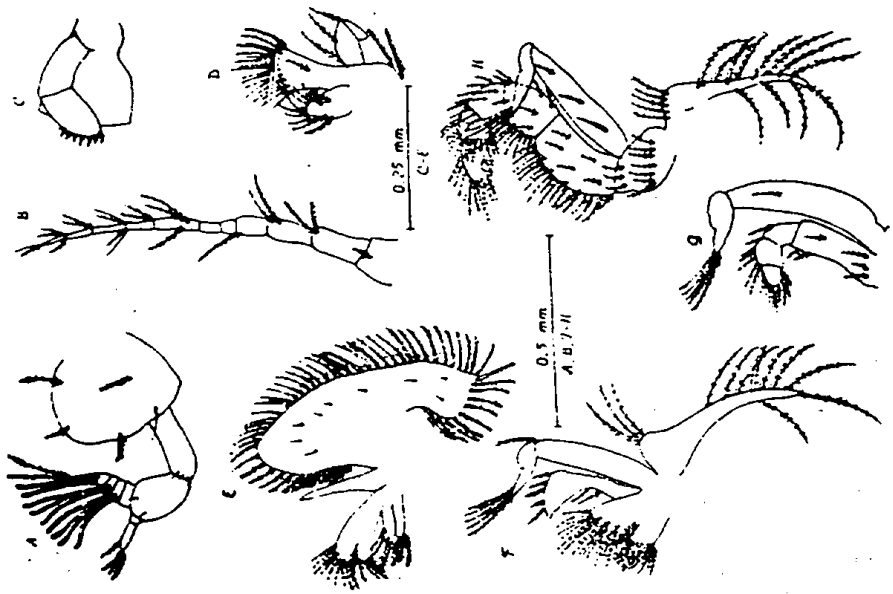


Fig. 7. Appendages of the megalopa of *Thalamita crenata*. A, Antennule; B, Antenna; C, Mandible; D, Maxillule; E, Maxilla; F, Maxilliped 1; G, Maxilliped 2; H, Maxilliped 3.

Carapace (Fig. 6A) : Longer than broad, laterally inflated, surface covered with hairs. Rostrum pointed, covered with simple setae, anterolateral border spines not yet appeared. Eyes large, projecting laterally. Ab and T (Fig. 6A,B): Somites 1-4 with bluntly rounded. Only somite 5 with long pointed posterolateral spines. Telson semicircular, with 1 long posterior, 2 long lateral plumose setae. Pl 1-4 (Fig. 6H): pleopods witb 20,19,19,18 plumose natatory setae, all endopods with 3 hooked cincinnuli. U (Fig. 6 I): Uropods with 11 exopodal plus 1 protopodal plumose seta. P 1-5 (Fig. 6 C-G): Chelipeds inflated, unarmed, equal, shorter than walking legs, cutting edges with pointed teeth. Second to fourth pereiopods elongate, similar, dactylus with spiny tip. Fifth pereiopod dactylus with 4 long terminally hooked. A1 ( Fig. 7A) : Peduncle 3-segmented, inflated, bulbous basal segment with 4 plumose plus 1 simple setae, middle and distal segments with 4,2 simple setae, respectively. Flagellar inner ramus 2-segmented with 0,2 plus 2 plumose setae. Outer ramus 4-segmented, with aesthetascs and plumose setae arranged, as 1 seta, 4 aesthetascs, 3 aesthetascs plus 2 setae, 2 aesthetascs plus 2 setae. A2 (Fig. 7B): Peduncle 4 segmented, with setal formula 1,2,2,1. Flagellum 8-segmented with setal formula 0,0,3,2,4,2,3,2. Md (Fig.7C): With smooth, thin cutting edge; palp 2-segmented with 0,7 setae. Max 1 (Fig. 7D) : Coxal and basal endite with 11 and 20 setae respectively. Endopod with 3 setae. Outer marginal setae still presented. Max 2 (Fig. 7E) 1 Coxal endite with 4,6 plumose setae. Basal endite with 6 plumodenticulate plus 1 simple seta on proximal lobe, distal lobe with 9 plumodenticulate setae. Endopod smooth. Scaphognathite with 67 marginal setae. Mxp 1 (Fig. 7F): Coxa and basis with 13, 30 setae respectively. Endopod unsegmented, with 7 plumose setae. Exopod 2-segmented, with 1,5 plumose setae. Epipod with 12 long setae. Mxp 2 (Fig.7G) : Endopod 4 segmented, with 6, 2, 5, 9 setae. Exopod 2-segmented, with 1,5 plumose setae. Mxp 3 (Fig. 7H) : Protopod with 10 setae. Endopod 5-segmented, with 23,15,10,14,11 setae. Exopod 2-segmented, with 3,5 plumose setae. Epipod with 12 setae distally plus 5 plumose setae proximally. Colour: Whole larva yellowish-orange in colour. Eyes black, eyestalk orange coloured with a red stellate chromatophore. Carapace with thin reticulate yellowish-brown chromatophores. Abdomen yellowish in colour.

*First instar crab* (Figs. 8,9)

Carapace length 1.57 mm; carapace width 1.79 mm; abdomen length 1.04 mm.

Carapace (Fig. 8A) : Now broader than long, laterally inflated, surface with numerous simple setae. Front rectangular serulate/crenulate margins, anterolateral broader with 4 large 1 small teeth. Eyes large, projecting laterlly. Ab and T (Fig. 8B): Six somites, each with simple setae as illustrated. Telson semicircular, with 7 plumose setae. P 1-5 (Fig. 8A,C,D) : Chelipeds massive, unarmed, equal, shorter than walking legs, gape of chelae with 8 small teeth on each side. Second to fourth pereiopods elongate, dactyls with spiny tip. Fifth pereiopod dorsoventrally flattened, with numerous long plumose setae on propodus and dactylus replacing earlier setae. A1

(Fig. 9A) : Peduncle 3-segmented, enlarged basal segment with 15 plumose setae, middle and distal segments with 6,3 setae, respectively. Inner ramus 3-segmented with 1,2,4 setae. Outer ramus 7-segmented with 0,6 aesthetascs, 6 aesthetascs plus 2

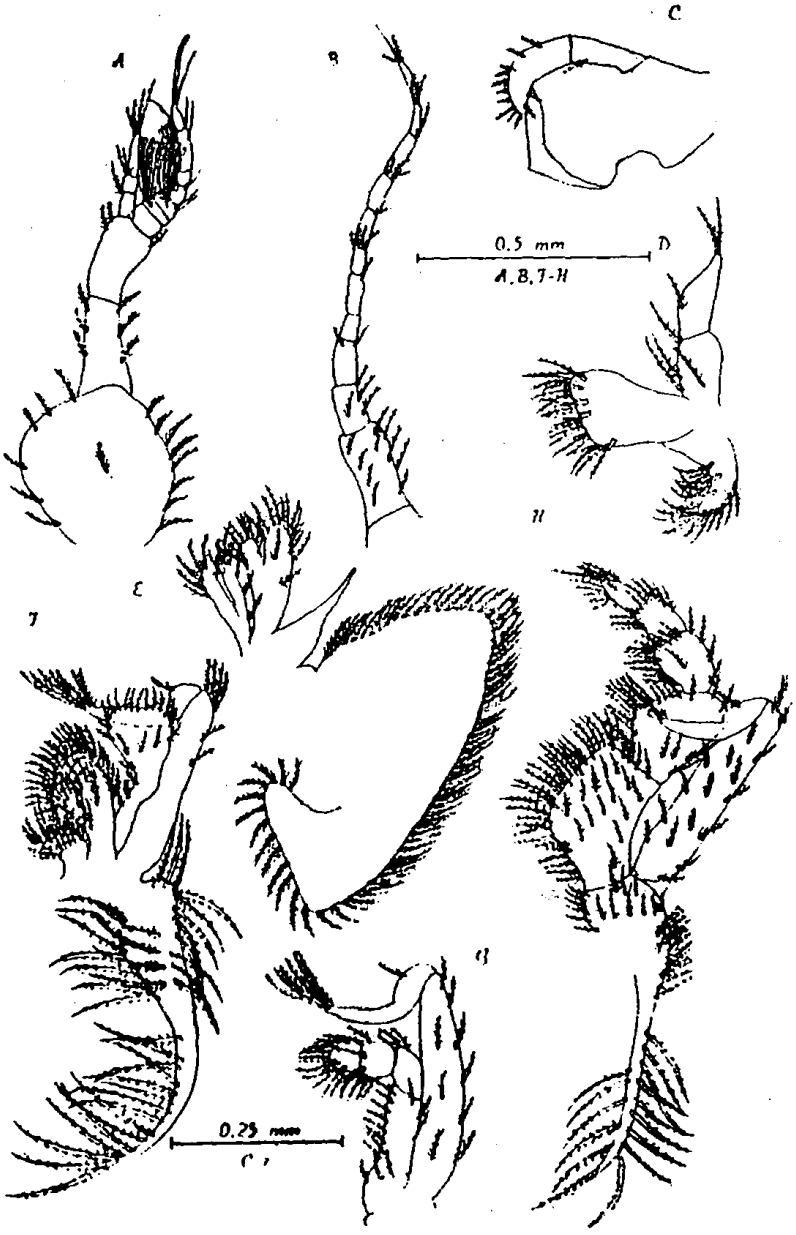


Fig. 9. Appendages of the first instar crab of *Thalamita crenata*. A, Antennule; B, Antenna; C, Mandible; D, Maxillule; E, Maxilla; F, Maxilliped 1; G, Maxilliped 2 & H, Maxilliped 3.

sample setae, 4 aesthetascs plus 1 simple seta, 0,1 aesthetascs plus 2 simple setae, 1 aesthetasc, plus 1 simple seta. A2 (Fig.9B): peduncle 4-segmented, with 0,10,4,2 plumose setae. Flagellum 8-segmented, with setal formula 0,1,4,1,3,1,3,3. Md (Fig. 9C): palp 2-segmented, with 1,11 +1 setae. Max 1 (Fig.9D): Coxal and basal endite with 19 setae respectively. Endopod 2-segmented with 4,3 setae. Max 2 (Fig.9E) : Coxal endite with 6,7 plumose setae. Basal endite with 9,13 plumose setae. Endopod naked. Scaphognathite with 73 marginal plumose setae plus 15 simple setae. Mxp 1 (Fig.9F): Coxa and basis with 19 and 46 setae respectively. Endopod with 22 setae. Exopod with 6,8 plumose setae. Epipod with 22 proximal plus 15 distal setae. Mxp 2 (Fig. 9G) : Endopod 5-segmented with 3,11,3,7,18 setae. Exopod 2-segmented with 9,7 plumose setae. Mxp 3 (Fig.9H): Protopod with 15 setae. Endopod 5-segmented, setal formula 48,20,17,10,9 setae. Exopod 2-segmented with 17,6 plumose setae. Epipod with 15 setae distally plus 14 setae proximally. Colour : Body yellowish- orange and carapace with black spots.

According to Bookhout and Costlow (1974) "the larvae within the subfamily Portuninae are so similar, that it is very difficult to tell species apart other than by examination of minute characteristics of those larvae which have been cultured from the egg". " Identification of larval Portuninae is particularly difficult " (Lebour, 1928; Roberts, 1969; Kurata, 1975; Rice and Ingle, 1975). "Identification of species of *Thalamita* is almost impossible without referring to every available minor differences" (Kurata, 1975).

All zoeal descriptions including the characteristic endopod of first maxilliped of zoea I of *T. crenata* are in full agreement with characters listed for Portuninae by Rice and Ingle (1975) and Rice.(1980). The zoeal stages (zoea I through zoea V) of the current study material *T. crenata* can easily be separated from one another with the aid of the number of natatory setae on the first and second maxillipeds, 4,6,8,10 and 12 setae respectively. Instead, the exopod setation of first and second maxillapeds is 4,9 and 12 setae, respectively, described by Thomas, Khan, Kannupandi and Natarajan (1980) in *T. crenata* larvae. According to Aikawa (1929) and Lucas (1971), the setal progression follows the usual sequence of 2's in the maxillipedal exopod of brachyurans. Thus the setal formula described by Thomas, Khan, Kunnupandi and Natarjan (1980) implies that the previously existing, intermediate zoeal stages II and III have been eliminated or skipped.

In Brachyura, there are variabilities in (1) the number of zoeal stages, (2) the morphology of zoeal stages, (3) the number of setae on appendages and (4) duration of larval sequence within a species (Goldstein, 1970; Gonor and Gonor, 1973; Costlow, 1965). Costlow (1965) listed three general types of variability in crab larvae, viz., (1) moulting without any perceptible morphological changes, (2) elimination or skipping of a larval stage while maintaining same moulting frequency and (3) moult which

results in a larval stage, which combines morphological characters normally attributed to two zoeal stages.

The morphological variations encountered in the developmental stages of Portunids may be intrinsic. Within the Brachyura, the number of zoeal stages found in various species ranges from 2 to 8. Only within the Portunidae do any species occur with more than five zoeal stages. For this reason it is considered to be the most primitive family within the Brachyura. Variability in the morphology of zoeal stages and seems to be rare in species with only a few stages and more common in species with many larval stages. Costlow (1965) suggested that the morphological variability found in the zoeal development of portunids is associated with the primitive nature of the family. Morphological variability may give the larvae the flexibility to survive and complete development over a wide range of rates of morphological development.

For 4 years (1984-87), the larvae of *T. crenata* have been reared under different culture conditions like salinity, starvation, diets (feeding different strains of *Artemia*), etc. Unlike in the previous studies, in all the rearing experiments, 5 zoeal stages appeared before moulting to megalopa. Hence, it is suggested that the observations of Thomas, Khan, Kannupandi and Natarajan (1980) may be incorrect and they might have overlooked the zoeal stages II and III. The 7 zoeal stages reported for Australian *T. crenata* (Greenwood and Fielder, 1979) may be due to environmental and geographical variations (Pasupathi and Kannupandi, 1988).

The megalopa of the present species of *T. crenata* can be separated from other known species by the setation of pleopods (20, 19, 19, 18 setae), setation of the peduncle of antennule (5,4,2 setae) setation of the flagellum of the antenna (0,0,3,2,4,2,3,2 setae) and setation of the basal endite of maxillule (20 setae) . Descriptions of first crab instar are known for *T.danae* (Krishnan and Kannupandi, 1988) . The first crab instar of *T.crenata* can be distinguished by the setation of the peduncle of the antenna (10,4,2 setae), basal endite of the maxillule (19 setae), epipod of the maxilliped 1 (37 setae) and endopod of the maxilliped 3 (48,20,17,10,9 setae).

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