

## Laboratory Reared Larval Stages of the Portunid Crab *Thalamita crenata* Milne Edwards

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Received 12 March 1980; revised received 17 June 1980

Three zoeal stages and a megalopa have been observed during development in the laboratory (sal.  $30 \pm 1\text{‰}$ ; temp.  $29^\circ \pm 1^\circ\text{C}$ ). Characteristics of the zoeal stages and the megalopa are described and compared with other known species of this genus. The zoeal stages and the megalopa can be readily differentiated from other known species based on dorsal spine, length and armature of different appendages, outer spine 1 of telson and sternal spine of leg 4.

Alcock<sup>1</sup> has recorded 21 species of *Thalamita* from the Indian waters, but information on the larval life history is available for only 1 species<sup>2</sup>. In Porto Novo (lat.  $11^\circ 29' \text{N}$ ; long.  $79^\circ 46' \text{E}$ ), this genus represented by *T. crenata* and *T. chaptali* supports a minor fishery along with other portunid crabs. They occur in considerable numbers among algae in tidal pools, estuaries and mangroves. The larval development of *T. crenata* has been studied by rearing the larvae in the laboratory.

### Materials and Methods

Ovigerous female crabs were collected from the Vellar estuary (lat.  $11^\circ 29' \text{N}$ ; long.  $79^\circ 46' \text{E}$ ) with a cast net. Each crab was maintained in a rectangular glass trough containing sea water and sand, until hatching occurred. As soon as the larvae were hatched, they were separated and reared in groups of 5 in small plastic trays each containing 100 ml of filtered sea water. No bactericides were used and water was changed daily. The presence of moult was carefully checked in each container before changing water. The larvae were fed daily with freshly hatched *Artemia* nauplii. The larvae and moults were preserved as suggested by Thakur<sup>3</sup>. Dissections were made with entomological needles under a low power binocular microscope in glycerine and camera lucida drawings made.

The salinity of sea water used was  $30 \pm 1\text{‰}$  and the temperature was  $29^\circ + 1^\circ\text{C}$ . Duration of a stage was taken as the time spent in a given instar by the larvae before successfully moulting to enter the next instar. Following measurements were made in fresh zoeal stages and megalopa: Zoeal stages—Rostral spine, from tip of rostrum to its base. Dorsal spine, from terminal outer edge of spine to its base. Carapace length, from the anterior edge of eyestalk to the posterior edge of carapace. Abdominal length, from 1st somite to tip of telson fork. Megalopa—Carapace

length, from tip of rostrum to posterior margin along middorsal line. Abdomen length, from 1st abdominal somite to hind end of telson. Telson processes were numbered following Kurata<sup>2</sup>.

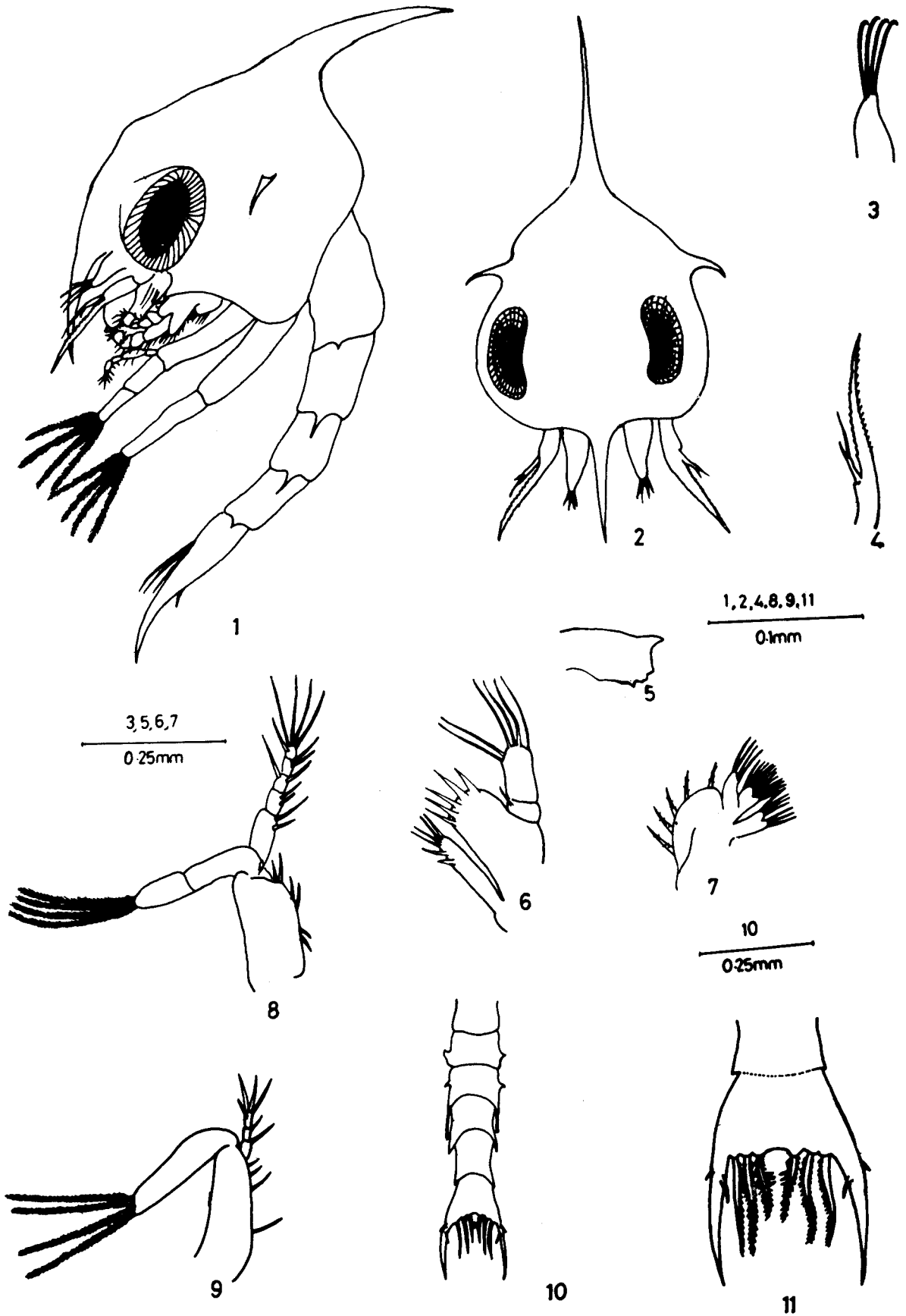
### Results

There were 3 zoeal stages and a megalopa. The shortest intermoult duration of each zoeal stage is 6, 4 and 5 days respectively for stages I to III.

*First zoea*—Rostral spine length = 0.18 mm; dorsal spine length = 0.22 mm; carapace length = 0.38 mm and abdomen length = 0.86 mm.

Carapace typical of portunid crabs with dorsal, rostral, and a pair of lateral spines, all smooth, dorsal spine curves backward, longer than rostral spine but shorter than carapace, rostral spine almost straight, lateral spines short, inconspicuous anterior dorsal knob present, eyes large and sessile, (Figs 1 and 2). A1 (Fig. 3): Uniramous with 4 long aesthetascs. A2 (Fig. 4): Exopod less than half the length of protopodite, with 2 terminal setae, 1 long, 1 short, protopodite serrated on both margins, slightly longer than rostrum, no endopod. Md (Fig. 5): Without palp and with well developed incisor process. Max 1 (Fig. 6): Coxal and basal endites with 6 and 5 setae respectively, endopod 2-segmented, distal segment with 4 terminal and 2 subterminal setae, proximal segment with 1 seta. Max 2 (Fig. 7): Coxal and basal endites bilobed, coxa with 3 and 4 setae on proximal and distal segments respectively, basis with 6 and 6 setae, endopod with 2 setae terminally and 2 setae subterminally, scaphognathite with 5 setae. Mxp 1 (Fig. 8): Basis with 6 setae,

Abbreviations used: A1, antennule; A2, antenna; Md, mandible; Max 1, maxillule; Max 2, maxilla; Mxp 1, 1st maxilliped; Mxp 2, 2nd maxilliped; Mxp 3, 3rd maxilliped; P<sub>1-5</sub>, pereopods 1-5; Pl<sub>1-5</sub>, pleopods 1-5; Ab, abdomen; T, telson and U, uropod.



Figs 1 to 11—First zoea of *T. crenata* [1, Entire larva (lateral view); 2, entire larva (dorsal view); 3, antennule; 4, antenna; 5, mandible; 6, maxillule; 7, maxilla; 8, 1st maxilliped; 9, 2nd maxilliped; 10, abdomen and 11, telson]

endopod 5-segmented, with 2,2,2,2,4+1 setae from proximal to distal segments, exopod 2-segmented with 4 natatory setae. Mxp 2 (Fig. 9): Basis with 4 setae, endopod 3-segmented, segments 1 and 2 with a setae each and segment 3 with 4 setae, 3 terminally and 1 subterminally, exopod unsegmented, with 4 natatory setae. Ab (Fig. 10): 5-segmented, segments 1 and 2 smooth, segments 2 and 3 with a pair of dorso-lateral protruberances, segments 3-5 with posterolateral spines, spines on segment 3 almost as long as that of segment 4. T (Fig. 11): Longer than wide, forked with a median notch on posterior margin, outer spine 1 visible only under high magnification; spine 2 hair-like, spine 3 bending inwards distally, place of insertion of outer seta 3 about  $\frac{1}{4}$  the length of fork, inner process formula 3+3, inner setae 1 more than half the length of fork.

All the 3 zoeal stages and the megalopa appear diffused yellowish, black chromatophores consistent over viscera extending along intestine as far back as abdominal somite 2. Diffused yellow chromatophores are present in all the abdominal somites and on the upper part of telson consistently in all the zoeal stages and megalopa.

*Second zoea*—Rostral spine length=0.55 mm; dorsal spine length=0.54 mm; carapace length=0.70 mm and abdomen length=1.33 mm.

Eyes stalked, rostral spine as long as or slightly longer than dorsal spine, ventral margin of carapace denticulated with few setae, 5 pairs of pereopod buds developed, first pair shows chelate nature (Fig. 12). A2 (Fig. 15): Protopodite of antenna longer than rostral spine, endopod developed as a bud. Md (Fig. 16): Molar process developed. Max 1 (Fig. 17): Coxa with 7 setae, basis with 11 setae, no change in endopod. Max 2 (Fig. 18): No change except increase in the number of setae on scaphognathite. Mxp 1 and 2 (Figs 19 and 20): Except increase in the number of natatory setae from 4 to 9 no other change. Mxp 3: Developed as a bud. Ab (Fig. 21): Posterolateral spines in somite 3 slightly longer than those of somite 4 and about  $\frac{3}{4}$  the length of somite 4, pleopod buds quite evident from segments 2-5. T (Fig. 22): Outer spines 1 and 2 disappear, a median pair of process added and the inner process formula becomes 4+4, median notch shallowed, telson about 2 times longer than wide, outer spine hardly visible.

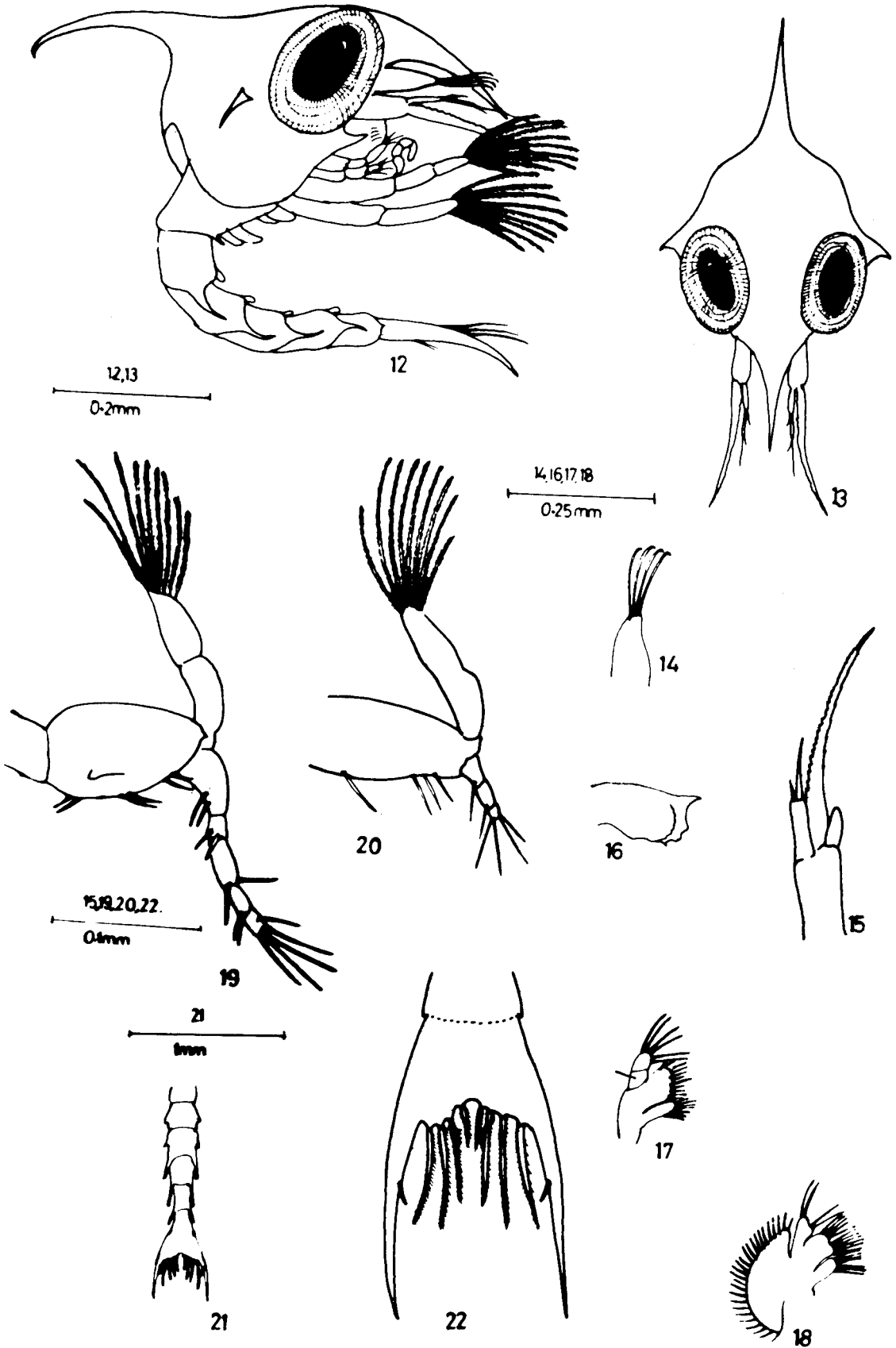
*Third zoea*—Rostral spine length=0.63 mm; dorsal spine length=0.63 mm; carapace length=1.10 mm and abdomen length=2.35 mm.

Rostral spine as long as dorsal spine, pereopod buds enlarged, rostral spine shorter than protopodite of antenna (Figs 23 and 24). A1 (Fig. 25): Biramous, inner ramus developed as a bud, outer ramus with 9 aesthetascs, 4 terminal and 5 subterminal. A2 (Fig. 26): Endopod bud enlarged, more than half the length of protopodite. Md (Fig. 27): Increased in size, palp not

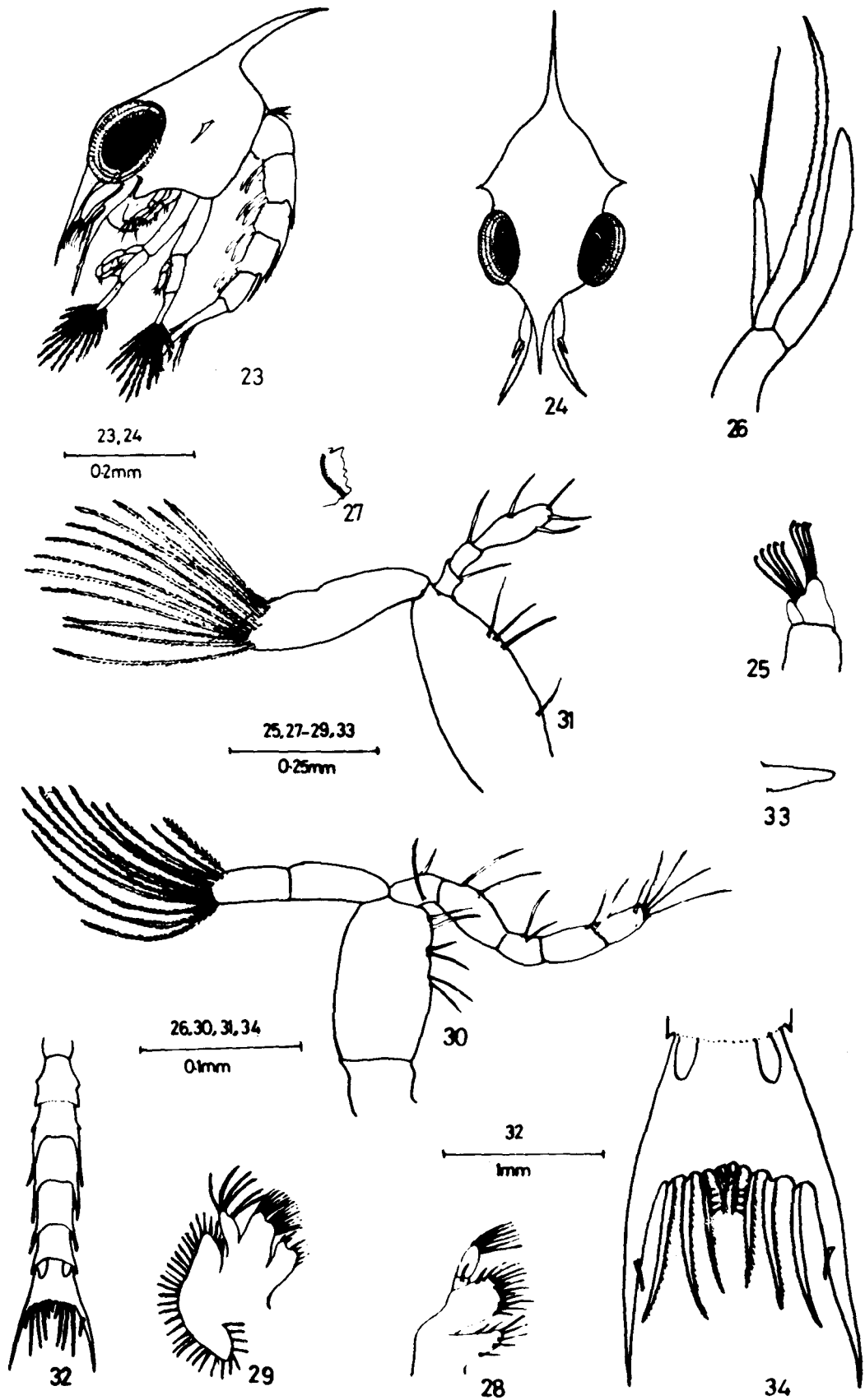
yet developed. Max 1 (Fig. 28): No change in distal segment setation, basis and coxa with 14 and 7 setae respectively. Max 2 (Fig. 29): Setae on scaphognathite 35-37, setae on endopod increased to 6, 4 terminal and 2 subterminal, basis with 6 and 8 setae on distal and proximal segments respectively, coxa with 5 and 3 setae on proximal and distal segments. Mxp 1 (Fig. 30): Enlarged in size, exopod with 12 natatory setae. Mxp 2 (Fig. 31): Enlarged in size, exopod with 12 natatory setae. Mxp 3: Bud enlarged. Ab (Fig. 32): With 6 somites, somite 6 being separated from telson, 4 pairs of uniramous pleopod buds developed from somites 2-5, uropod bud (Fig. 33) seen at the end of somite 6, postero-lateral spine on somite 3 almost touches the base of spine on somite 4. T (Fig. 34): About  $1\frac{1}{2}$  times longer than broad, all spines intact, a median process added and inner process formula becomes 4+1+4, first process of inner setae more than half the length of fork.

*Megalopa*—Carapace length=1.52 mm; abdomen length=1.02 mm and total length=2.50 mm.

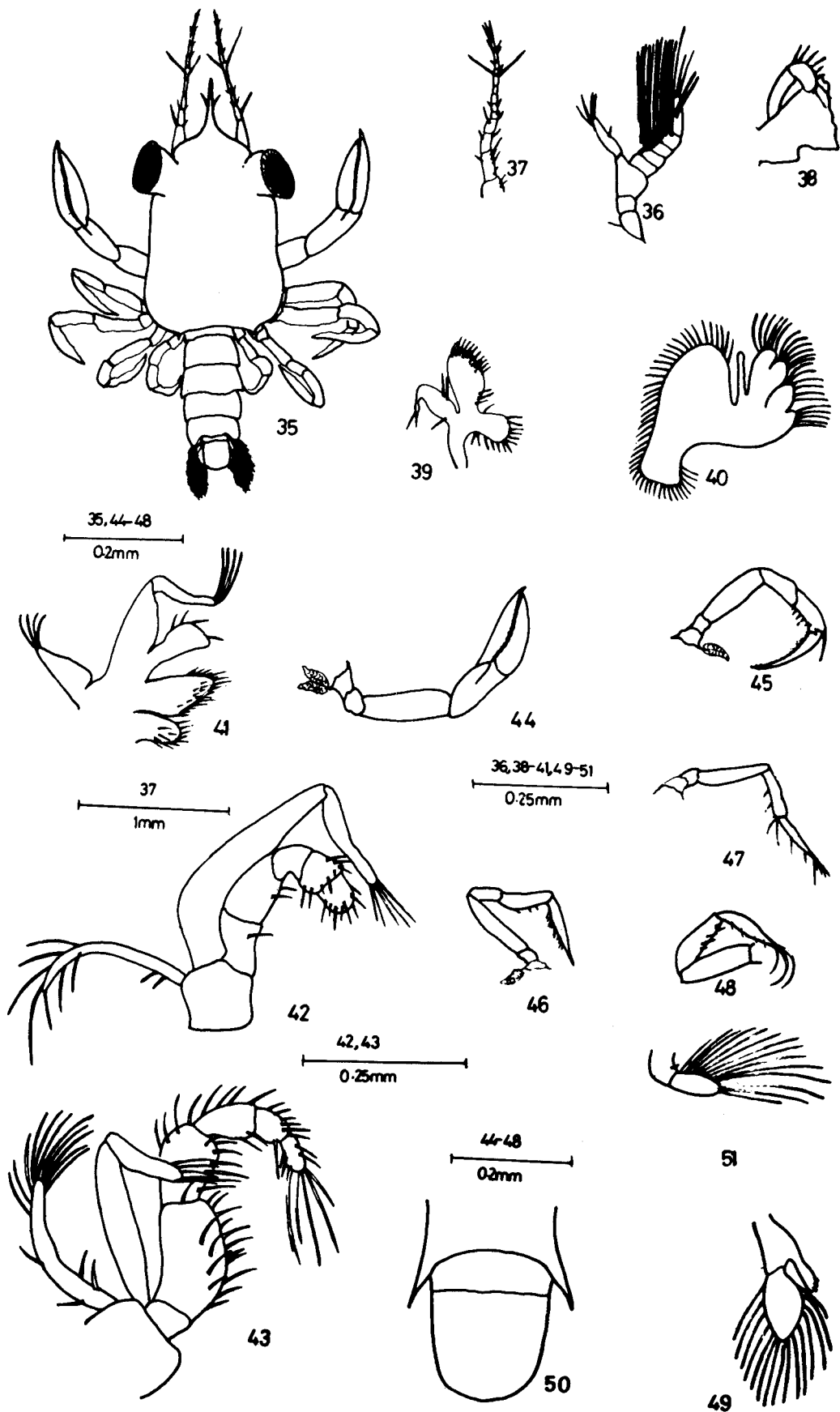
Carapace with a square rostrum, the centre produced into a long spine sticking out forward almost horizontally, about half as long as rest of rostrum, rostrum bears few setae, carapace smooth, without any protruberances or dorsal spines, eyes large (Fig. 35). A1 (Fig. 36): Biramous, peduncle 3-segmented, inner ramus unsegmented with 5 setae, 3 terminal, 1 subterminal and 1 in the middle, outer ramus 5-segmented, segments 2-4 bear 12 long aesthetascs, terminal segment with 2 terminal and 2 middle setae. A2 (Fig. 37): Flagellum exceeds tip of rostrum by 4 flagellar segments, peduncle 4-segmented, flagellum 8-segmented, segment 5 of flagellum with a pair of long setae at its distal end; last segment of flagellum with 3 setae terminally. Md (Fig. 38): Mandible spoon shaped, 2-segmented palp, proximal segment without seta, and distal segment with 7 setae, palp bends inside the cutting edge. Max 1 (Fig. 39): Basal endite with 20 terminal setae, 3 setae on lower margin, coxal endite with 13 setae, endopod unsegmented and bears 5 setae. Max 2 (Fig. 40): Shows somewhat degenerated features compared to that in the last zoea in the setation of endites and in endopod being without setae, scaphognathite greatly enlarged and fringed with numerous setae. Mxp 1 (Fig. 41): Bilobed, protopod with 12 and 27 setae respectively on proximal and distal lobes, endopod short flattened, unsegmented and with 4 setae, exopod 2-segmented with 4 plumose setae distally, epipod comparatively shorter than other maxillipeds and with 4 setae at its distal end. Mxp 2 (Fig. 42): With 5-segmented endopod, with 1, 2, 0, 8, 8 setae from proximal to distal segments, exopod 2-segmented with 5 apical setae on its distal segment, epipod long and bears 7 setae distally and 2 setae



Figs 12 to 22—Second zoea of *T. crenata* [12, Entire larva (lateral view); 13, entire larva (dorsal view); 14, antennule; 15, antenna; 16, mandible; 17, maxillule; 18, maxilla; 19, 1st maxilliped; 20, 2nd maxilliped; 21, abdomen and 22, telson]



Figs 23 to 34—Third zoea of *T. crenata* [23, Entire larva (lateral view); 24, entire larva (dorsal view); 25, antennule; 26, antenna; 27, mandible; 28, maxillule; 29, maxilla; 30, 1st maxilliped; 31, 2nd maxilliped; 32, abdomen; 33, pleopod and 34, telson]



Figs 35 to 51—Megalopa of *T. crenata* [35, Dorsal view of megalopa; 36, antennule; 37, antenna; 38, mandible; 39, maxillule; 40, maxilla; 41, 1st maxilliped; 42, 2nd maxilliped; 43, 3rd maxilliped; 44, cheliped; 45, 2nd leg; 46, 3rd leg; 47, 4th leg; 48, 5th leg; 49, pleopod; 50, uropod and 51, telson]

Table 1—Comparison of the First Zoecal Stage of *T. crenata*

Character	Prasad and Tampi <sup>4</sup>	Chhappgar <sup>3</sup>	Present study
Rostral spine length (mm)	0.23	0.188	0.18
Dorsal spine length (mm)	0.275	0.238	0.22
Antennal aesthetascs	3	1	4
Setae on coxa of maxillule	5	—	7
Setae on basis of maxillule	8	—	12
Setae on basis of I maxilliped	5	—	—
Setal formula in endopod of I maxilliped	2, 2, 0, 2, 5	—	2, 2, 2, 2, 5
Setae on basis of II maxilliped	3	—	4
Median abdominal spines	Absent	Present	Absent
No. of outer spines in telson	2+2	1+1	3+3

Table 2—Distinguishing Characters Between Larval Stages of *T. crenata* and *T. sima*

Stage	Character	<i>T. crenata</i>	<i>T. sima</i>
I	Antenna	Protopod slightly longer or equal to rostral spine	Longer than rostral spine
	Uropod	—	—
II	Antenna	Endopod bud developed	Endopod bud not developed
	Maxillipeds	9 natatory setae	6 natatory setae
	Abdomen	Pleopod buds visible	Not visible
III	Rostrum	Endopod bud larger	Small
	Maxillipeds	12 natatory setae on exopod	8 natatory setae on exopod
	Abdomen	Pleopods well developed	No pleopods
	Telson	Inner process formula 4+1+4	Inner process formula 4+4
IV	Antenna	—	Almost as long as rostral spine
	Maxillipeds	—	9-10 natatory setae on exopod
	Abdomen	—	Pleopod buds developed
	Telson	—	Inner process formula 4+4
V	Unropod	—	Buds not yet developed
	Uropod	—	Buds not yet developed
Megalopa	Sternal spine of leg 4	Moderate in length, visible from above	Small, not visible from above

proximally. Mxp 3 (Fig. 43): Endopod 5-segmented, ischium longest segment, ischium, merus, carpus, propodus and dactylus with 15, 12, 6, 7, 9 setae respectively, exopod 2-segmented, 4-5 terminal setae on distal segment, no seta on proximal segment, epipod long and bears 3 setae proximally, 1 middle and 11 setae terminally. P<sub>1-5</sub> (Figs 44-48): First pair of pereopods equal, chelate, fingers with 4 teeth each along cutting edges, ischial and carpal spines absent, finger tips cross each other in closed condition of chela, leg 2 with spine on ventral edge of coxa, dactyli of legs 2-4 longer than propodi, with several prickly spines along ventral edge, last segment of leg 5 paddle shaped ending in a spine, with setae and a few feelers along ventral edge, sternal spine at base of leg 4 is larger than spine on coxal endite of leg 2 but smaller than the sternal spine of closely related genera, it touches about ¼ the length of abdominal somite 2. Ab: 6-segmented, shorter than carapace, postero-lateral border of first 4 segments smooth and without spines, postero-lateral spine on somite 5 extends to about ¼ the length of telson, 4 pairs of biramous pleopods on somites 2-5, no seta on protopod, exopod with 15 setae, endopod small, non-setose, with 3 microscopic hooks (Fig. 49). T (Fig. 50): Telson as long as wide and tapers slightly behind. U (Fig. 51): Uniramous, exopod with 14 setae and protopod with a single seta.

**Discussion**

Prasad and Tampi<sup>4</sup> described the pre-zoecal and 1st zoecal stages of *T. crenata* from laboratory studies. Subsequently, Chhappgar<sup>5</sup> described only the 1st zoecal stage. In the present study no pre-zoecal stage was found. Differences reported in the 1st zoecal stage of *T. crenata* from 3 different sources is given in Table 1. Kurata<sup>2</sup>, who described the larval life history of *T. sima* and the 1st zoecal stage in *T. prymna* from Japan also did not report the occurrence of a pre-zoecal stage. *T. sima* from Japan, was reported to pass through 5 zoecal stages before reaching the megalopa stage but in the present study, *T. crenata* was found to pass through only 3 zoecal stages. Zoecal numbers between species and even within a species may vary under different cultural conditions<sup>6</sup>. The 3 zoecal stages and megalopa of *T. crenata* could also be separated from the 5 zoecal stages and megalopa of *T. sima* by the characters mentioned in Table 2. Observations on dorsal spine and outer spine 1 of telson led Kurata<sup>2</sup> to distinguish the larvae of *Thalamita* from the larvae of closely related genera like *Portunus* and *Charybdis*. These characters hold good for the present study also.

**Acknowledgement**

The authors are grateful to CSIR and UGC, New Delhi for financial support.

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